Series 1956, No. 21
Issued April 1963
Also issued as South Dakota
Experiment Station Bulletin No. 511

SOIL SURVEY

Hand County, South Dakota

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
in cooperation with
SOUTH DAKOTA AGRICULTURAL EXPERIMENT STATION

HOW TO USE THE SOIL SURVEY REPORT

THIS SURVEY of Hand County, S. Dak., will serve several groups of readers. It will help farmers and ranchers in planning the kind of management that will protect their soils and provide good yields; assist engineers in selecting sites for roads, buildings, ponds, and other structures; and add to our knowledge of soil science.

Locating soils

Use the index to map sheets at the back of this report to locate areas on the large map. The index is a small map of the county on which numbered rectangles have been drawn to show where each sheet of the large map is located. When the correct sheet of the large map has been found, it will be seen that boundaries of the soils are outlined, and that there is a symbol for each kind of soil. All areas marked with the same symbol are the same kind of soil, wherever they occur on the map. The symbol is inside the area if there is enough room; otherwise, it is outside the area and a pointer shows where the symbol belongs.

Finding information

This report contains sections that will interest different groups of readers, as well as some sections that may be of interest to all.

Farmers and ranchers and those who work with them can learn about the soils in the section "Descriptions of the Soils" and then turn to the section "Use and Management of the Soils." In this way, they first identify the soils on their farm and then learn how these soils can be managed and what yields can be expected. The "Guide to Mapping Units" at the back of the report will simplify use of the map and report. This guide lists each soil and land type mapped in the county, and the page where each is described. It also lists, for each soil and land type, the capability unit and range site, and the page where each of these is described.

Engineers will want to refer to the section "Engineering Applications." Tables in that section show characteristics of the soils that affect engineering.

Land appraisers will be interested in the detailed soil map and in the sections "Estimated Yields" and "Descriptions of the Soils."

Scientists and others who are interested will find information about how the soils were formed and how they were classified in the section "Genesis, Classification, and Morphology of the Soils."

Students, teachers, and other users will find information about soils and their management in various parts of the report, depending on their particular interest.

Newcomers in Hand County will be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the section "General Nature of the Area," which gives additional information about the county.

The Hand County Soil and Water Conservation District was formed in 1942. This survey was made as a part of the technical assistance offered to farmers of the county through the services of the Agronomy Department, Agricultural Experiment Station, South Dakota State College, and the Soil Conservation Service. The survey was completed in 1956 and, unless otherwise indicated, all statements in this report refer to conditions at that time.

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C.

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UNITED STATES DEPARTMENT OF AGRICULTURE IN COOPERATION WITH THE SOUTH DAKOTA AGRICULTURAL EXPERIMENT STATION

General Nature of the Area

HAND COUNTY is in the east-central part of South Dakota (fig. 1). It has an area of 919,040 acres, or 1,436 square miles. The county extends 48 miles from north to south and 30 miles from east to west.

Agriculture is the main enterprise in the county. Corn, oats, wheat, and hay are the principal crops. Beef and dairy cattle, sheep, and hogs are the principal livestock.

Organization and Population

Hand County was named for George H. Hand, who was active in politics when this area was part of the Dakota Territory. The county was created in 1873, but the present boundaries were not established until 1879. In 1881, part of the county was opened for settlement, and by 1884 most of the area had been claimed. In 1960, the population of the county was 6,712. That of Miller, the county seat, was 2,081.

Miller is in the center of the county, at the junction of State Highway 45 and U.S. Highway No. 14. It was established in 1880, along with Ree Heights, St. Lawrence, Vayland, and Wessington, when the Chicago and North Western Railway was constructed across the county.

Physiography and Surface Geology

The boundary between the subhumid lowland of eastern South Dakota and the more arid Great Plains area of central and western South Dakota passes through Hand County (fig. 2). The western and southern parts of the county are in the Missouri Coteau, and the northeastern and east-central parts are in the James River lowland.

Hand County is located on part of the divide area between the James River basin and the streams that flow southwest to the Missouri River (fig. 3). All but the southwestern part and the area along the southern border are drained by streams that flow into the James River.

The Ree Hills, which are about 2,000 feet above sea level, make up the highest area in the county. The northeastern corner, which is about 1,350 feet above sea level, is the lowest part of the county. Although the area north of Ree Heights, Miller, and Vayland appears level, there is a fall of about 450 feet along the county boundary west of Ree Heights to the northeastern corner of the county. There is also a fall of about 300 feet from the Ree Hills to the southwestern corner of the county.

The geologic forces that formed the hills, the creeks, and other surface features of Hand County have been at work for a long time. Water erosion is the principal geologic force that can be observed today, though the effects of wind erosion may be evident in dry fallow fields. The disposition of soil parent material during geologic periods has also been important in shaping the surface of the county.

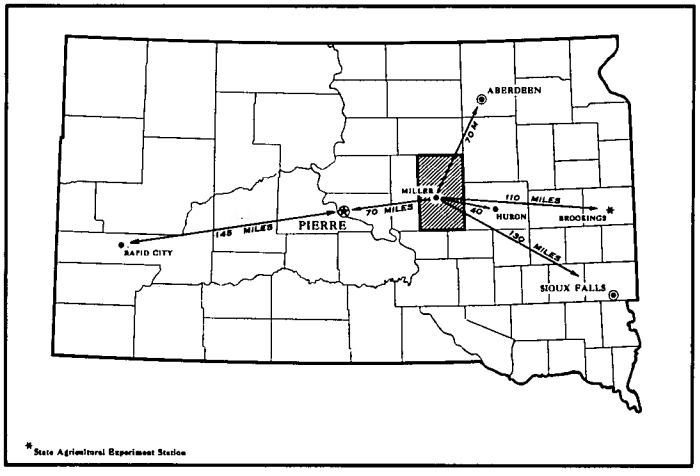

Figure 1.--Location of Hand County in South Dakota.

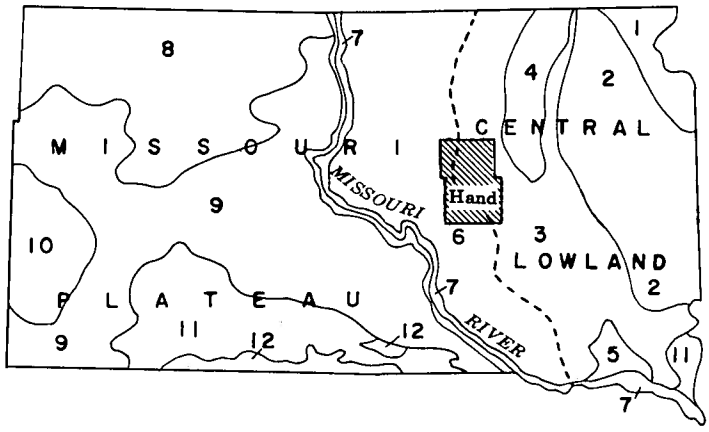

Figure 2.--Physical divisions of South Dakota: (1) Minnesota River-Red River lowland: (2) Prairie Coteau; (3) James River lowland; (4) Lake Dakota plain; (5) James River highlands; (6) Missouri Coteau; (7) Missouri River trench; (8) northern plateaus; (9) Pierre hills; (10) Black Hills; (11) southern plateaus; (12) Sand Hills (3). [1]

[1] Underlined numbers in parentheses refer to Literature Cited, p. 107.

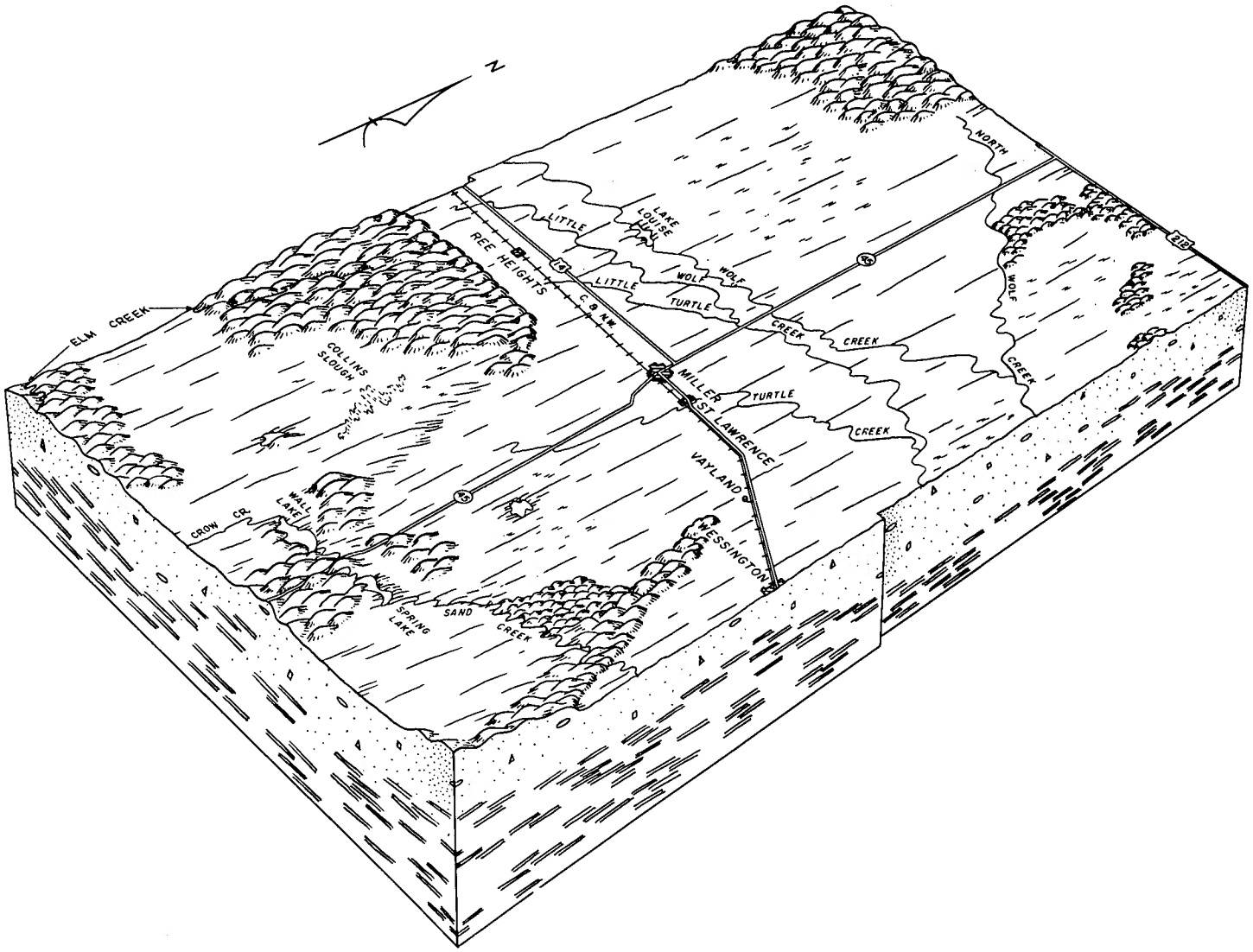

Figure 3.--Surface features of Hand County.

The oldest parent material exposed in Hand County was laid down millions of years ago during the Cretaceous period. The central part of the United States was then an ocean. Rivers in adjacent land areas washed silt and clay into the ocean, and the material settled to the bottom. The ocean floor was gradually raised by this filling process and by a movement of the earth's crust, and eventually a new area of land was formed. Pierre shale, the main upper bedrock in Hand County, has formed from the silt and clay deposited in the ancient ocean.

After the new land area was exposed, rivers and streams gradually removed all or most of the ancient deposits that were above the Pierre shale. Later, glaciers passed over what is now eastern South Dakota, and the landscape that formed in the shale was altered and was covered with glacial deposits. However, some features of the landscape that existed before the glacial age can still be seen.

The Ree Hills and Orient Hills are part of the higher ground on opposite sides of an old river valley. The ancient river that flowed through this valley probably came from the area now drained by the Bad River, went through east-central South Dakota and across Hand County north of Ree Heights and Miller, and then continued southeast to the Missouri River. The Missouri River, as it occurs in central South Dakota, was formed at the margin of a glacier that covered eastern South Dakota.

The glaciers smoothed out most of the high ground between the ancient rivers that flowed in an easterly direction across central South Dakota. The glacial ice deposited material over the bedrock. This material is called till and is composed of fragments of bedrock crushed by the moving ice. The large granite and limestone boulders in the county are from bedrock exposed farther to the north. The soft shale fragments in most of the glacial deposits are from the local bedrock.

Large streams of water that came from melting ice flowed in and out of the glaciers. The smaller particles (clay and silt) were washed away, and sand and gravel were deposited along the

meltwater streams. Most gravel found along the present streams in the county was deposited by meltwater. Gravel was also deposited by the streams that flowed in or at the edge of the glaciers; thus, these deposits are not necessarily along present streams.

Each of the several glaciers that moved into Hand County carried some new material and mixed it with material already present. Only the last two glaciers left deposits that are important as soil parent material (fig. 4). The older Cary glacier covered the entire county, and the succeeding Mankato glacier covered all but the southern part. The area covered by the Mankato glacier, as shown in figure 4, is based on a map of glaciated areas of South Dakota (3).

Studies in Minnesota by Wright and Rubin (10) indicate that deposits referred to as of the Mankato age may have been laid down in what is considered the Cary age; therefore, the deposits referred to as of the Cary age would be older than previously supposed.

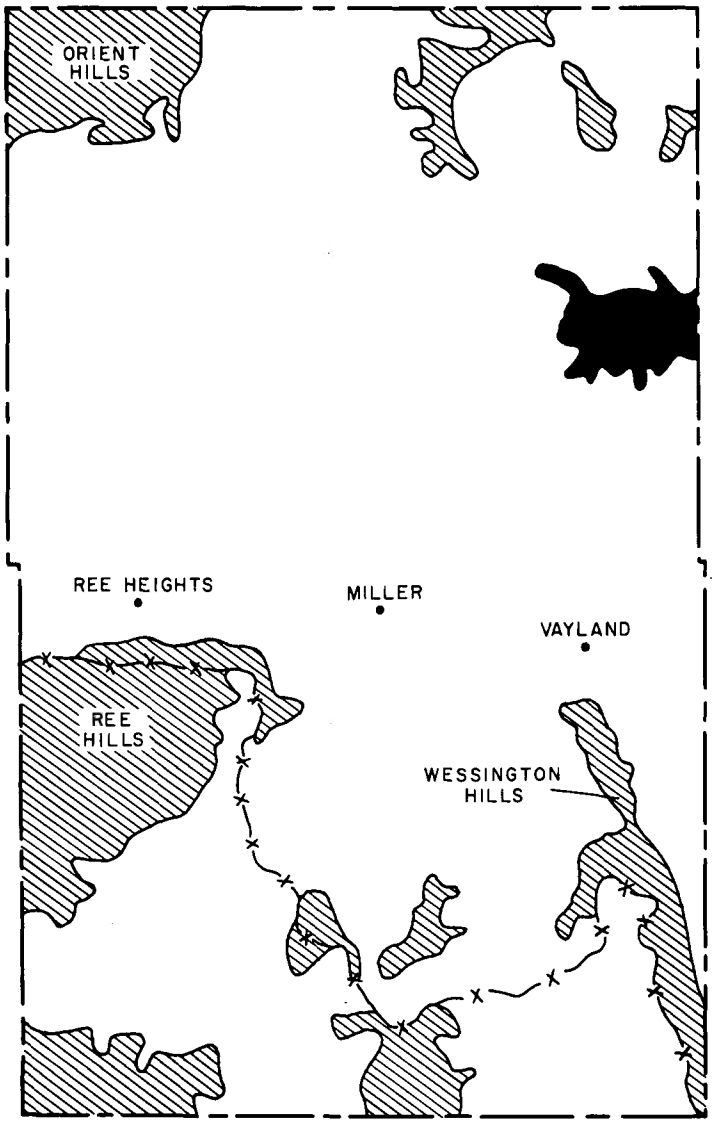

Figure 4.--Location of the main glacial deposits in Hand County.

Generally, the Cary till that is parent material of soils in the southern part of the county is more olive in color and contains more shale fragments than the Mankato till. Soils formed from the Cary deposits have had a few thousand years longer to develop than those formed from the Mankato deposits. Differences in the length of time the soils have had to form and in the composition of the till account for most of the differences between soils in areas of Cary till and those in areas of Mankato till.

A silty material, called loess, was deposited by winds after the melting of the Cary glacier. This material occurs in patches on the Cary till, and is the parent material of most soils not formed from glacial deposits. Not much loess was deposited following the Mankato glacier. Nevertheless, near the northwestern corner of the county, a very small area of Mankato till is mantled with loess.

The loess, which is a few feet thick, collected in places protected from winds. Thus, more of it has collected in depressions and small gullies than on the higher areas. As a result, the landscape has become more nearly level.

Water erosion that occurred after the glaciers also helped level the landscape by rounding steep banks and filling in low areas. Where the slope was steep, this leveling process was generally accompanied by the formation of gullies. Gullies at the edge of the Ree Hills, Orient Hills, and Wessington Hills indicate a stage in the leveling process. The topography in these areas is very rough.

Climate[2]

Hand County has a continental climate. Winters are long and cold, and summers are fairly warm. Most of the precipitation occurs late in spring and early in summer. Winter is the driest season. The county is subject to frequent changes in weather during the course of a week or two. Air masses that pass through the area bring a wide variety of temperature, moisture, and other weather conditions. The seasonal and monthly climate varies widely from year to year.

Temperature and precipitation data, compiled at the U.S. Weather Bureau station in Miller, are given in table 1. The data are based on weather observations during the 30-year period, 1931-60.

Temperature

Temperatures fluctuate considerably in Hand County. The occurrence of several consecutive days with little change in daily extremes is exceptional. Occasionally, however, hot weather in summer or very cold weather in winter persists from several days to more than a week.

The county is subject to strong, gusty winds and rapid falls in temperature. Late in fall, in winter, and early in spring, cold fronts have lowered temperatures as much as 40 to 50 degrees within 24 hours.

[2] By A. Boyd Pack, State climatologist, U.S. Weather Bureau, Huron, S. Dak.

TABLE 1.--Temperature and precipitation at Miller, Hand County, S. Dak.

Month	Temperature				Precipitation					
			7 years in 10 will have--					3 years in 10 will have--		
	Average daily maximum	Average daily minimum	Monthly maximum equal to or higher than--	Monthly minimum equal to or lower than--	Average monthly total	Maximum monthly total	Minimum monthly total	More than--	Less than--	Average snowfall
	°F.	°F.	°F.	°F.	Inches	Inches	Inches	Inches	Inches	Inches
January---	26	5	43	-16	0.5	2.9	(1/)	0.6	0.2	5.7
February--	30	9	44	-13	.5	1.1	(1/)	.7	.3	6.9
March-----	41	20	60	0	1.0	3.0	(1/)	1.4	.6	7.8
April-----	59	34	79	19	2.2	5.6	0.1	2.5	1.4	3.9
May-------	71	45	86	31	2.5	7.9	.1	2.9	1.7	(1/)
June------	81	55	93	43	3.8	8.7	.2	4.4	2.6	.0
July------	89	61	100	50	2.1	5.6	.1	2.8	1.4	.0
August----	87	59	100	47	2.1	7.1	.4	2.4	1.2	.0
September-	77	49	94	34	1.4	5.0	(1/)	1.5	.6	(1/)
October---	64	37	83	22	1.3	4.0	(1/)	1.7	.5	.7
November--	44	23	63	5	.7	2.6	.0	.7	.3	3.8
December--	32	11	48	-7	.5	2.2	(1/)	.6	.2	4.9
Year-	58	34	----	----	18.6	2/29.3	3/9.6	4/20.5	5/15.0	33.7

1/Trace.
2/Total precipitation in wettest year (1942).
3/Total precipitation in driest year (1936).
4/Annual precipitation in 3 years in 10 is more than 20.5 inches.
5/Annual precipitation in 3 years in 10 is less than 15.0 inches.

Temperatures of 90 degrees or higher occur on an average of 30 to 35 days per year. About two-thirds of these days are in July and August. The number of days in summer that have temperatures of 90 degrees or higher ranges from less than 20, in cool summers, to more than 45, in especially warm summers. In about 6 years out of 10, temperatures of 90 degrees or higher occur before the end of May. Such temperatures are rare in April. They are common in September, however, and occur in October in about 3 years in 10.

Normally, daytime temperatures reach 100 degrees or higher on 3 to 5 days each summer, but the number of days in summer that have such readings ranges from none, in some years, to 7 or more, in others. Hand County has temperatures of 100 degrees more often than counties in the extreme eastern part of the State, but not so often as counties in the southwestern part.

In winter, on an average, temperatures of zero or lower are observed on 30 days. The number of days that have such temperatures fluctuates greatly from year to year, however. In some winters, temperatures of zero or lower are observed on more than 40 days, and in others, on less than 20 days. These low temperatures may be expected before the end of November in about 4 years out of 10, and as late as the early part or middle of March in about 6 years out of 10. In nearly every winter, a temperature of 20 degrees below zero or lower can be expected on at least 1 day. Temperatures of 30 degrees below zero or lower are rare, however. On most days between the middle of December and the middle of February, the temperature does not exceed 32 degrees.

The average date of the last temperature of 32 degrees or lower in spring is May 16, and the average date of the first temperature of 32 degrees or lower in fall is September 25. In most years the last freezing temperature occurs between May 1 and May 20, and the first, between September 20 and October 10. Data on the probabilities of freezing and near freezing temperatures at Miller are given in table 2.

The average freeze-free season is 131 days, but over a span of 54 years, the freeze-free season has ranged from 82 to 165 days. In 7 years out of 10, the freeze-free period ranges from 120 to 150 days.

Precipitation

The annual precipitation normally is about 1.5 inches greater in the southeastern and east-central

TABLE 2.--Probabilities of last freezing (or near freezing) temperatures in spring and first in fall at Miller, Hand County, S. Dak.

Probability	Dates for given probability of temperature					
	16° F.	20° F.	24° F.	28° F.	32° F.	36° F.
Spring:						
1 year in 10 later than---	April 20-----	May 6--------	May 12-------	May 14-------	May 27-------	June 3.
2 years in 10 later than--	April 12-----	April 22-----	May 6--------	May 9--------	May 21-------	May 27.
5 years in 10 later than--	March 29-----	April 11-----	April 21-----	April 26-----	May 10-------	May 18.
Fall:						
1 year in 10 earlier than-	October 14---	October 6----	September 28-	September 22-	September 14-	August 30.
2 years in 10 earlier than.	October 26---	October 14---	October 7----	September 25-	September 20-	September 11.
5 years in 10 earlier than.	November 5---	October 29---	October 20---	October 4----	September 29-	September 19.

parts of the county than in the northwestern and west-central parts.

At Miller, precipitation from April through September normally totals 13 or 14 inches, or about 75 percent of the amount expected annually. In 6 years out of 10, the April-September total ranges from 11 to 17 inches. During the growing season of small grain (April through July), the normal rainfall is about 10 or 11 inches, but a range from 7 to 13 inches can be expected 6 years out of 10. If well distributed, the rainfall is ample for the production of crops grown in the county. Nearly every growing season, however, has one or more extended periods of deficient rainfall.

Studies of climatological data have been made by Pengra (6) for that part of the State in which Hand County is located. These studies show that the amount of moisture held in the soil normally increases in April, and that the maximum amount, about 70 percent of the moisture-holding capacity, is reached during May. On the average, the moisture in the root zone for crops declines to 50 percent or less of the moisture-holding capacity by the early part of July. When this occurs, a condition of drought exists. After the early part of July, the soil moisture normally remains at less than 50 percent of capacity for the rest of the growing season.

Pengra (5) has found that between the early part of April and mid-July, there are as many as 50 drought days in 3 years out of 10. A drought day is defined as one on which the soil contains less than 50 percent of the available moisture it can hold at full capacity. Drought days may occur singly or in a series, according to Pengra.

The amount of precipitation that occurs during fall and early in spring appears to be very important to the success of crops produced in the following growing season. The ground normally is frozen hard by the late part of November or early part of December, and it remains frozen until about mid-March. Consequently, little moisture enters the soil. Studies made in Iowa (7) suggest that precipitation from December through February contributes very little to soil-moisture reserves. Therefore, near normal to above normal precipitation in October and November and again in March and the early part of April is very valuable in increasing moisture reserves in the soil. These reserves help crops withstand the adverse effects of subnormal or poorly distributed rainfall in the growing season that follows. Conversely, a decided shortage of precipitation in fall and again in the early part of spring endangers the success of crops grown the following summer, unless growing-season precipitation is above normal and, most important, well distributed.

During the growing season, most precipitation comes from showers of short duration, rather than from steady, but less intense rainfall that lasts several hours to more than a day. A rainfall of 1 inch or more in 24 hours occurs one or more times during the growing season. A rainfall in excess of 2 inches is recorded about once in 2 years, and one of 3 inches or more, about once in 5 years.

Average precipitation by weeks, based on a 53-year record of the Weather Bureau station at Miller (4), is as follows:

Week beginning--	Inches of precipitation
January 3	0.13
January 10	.10
January 17	.08
January 24	.10
January 31	.11
February 7	.10
February 14	.11
February 21	.10
March 1	.14
March 8	.18
March 15	.19
March 22	.32
March 29	.21
April 5	.40
April 12	.40

Week beginning--	Inches of precipitation
April 19	0.57
April 26	.67
May 3	.48
May 10	.61
May 17	.50
May 24	.80
May 31	.83
June 7	.85
June 14	.77
June 21	.91
June 28	.68
July 5	.54
July 12	.47
July 19	.43
July 26	.48
August 2	.60
August 9	.47
August 16	.55
August 23	.29
August 30	.26
September 6	.51
September 13	.30
September 21	.31
September 27	.28
October 4	.37
October 11	.19
October 18	.25
October 25	.22
November 1	.16
November 8	.13
November 15	.13
November 22	.11
November 29	.11
December 6	.10
December 13	.07
December 20	.09
December 27	.10

The data on average precipitation by weeks show that 0.50 inch or more of rainfall can be expected every week from mid-April through the early part of July. The greatest amounts of weekly rainfall occur from the last part of May through the last part of June. Weekly rainfall decreases from about 0.50 inch in July and August to about 0.30 inch by the late part of September. In the growing season of any one year, however, the rainfall received in successive weekly periods usually varies widely.

A week or more of high temperatures, accompanied by little or no precipitation, may occur during the growing season, mainly from late in June through the first half of August. These conditions result in rapid loss of moisture in the upper layers of the soil, in injury to plants, and in lower yields or poorer quality of crops, particularly if there is not enough moisture in the subsoil.

During the growing season (April-September), there are normally four or five periods of 7 days each during which the daily maximum temperatures average 85 degrees or higher and the precipitation for each 7-day period is 0.10 inch or less. A survey of weather records covering 10 years shows that the number of such 7-day periods has ranged from at least two in every growing season to as many as six periods in every 4 years out of the 10. Often two, and occasionally three, of these 7-day periods occur consecutively in the same season.

In winter almost all precipitation is in the form of snow. Because most heavy snowstorms are accompanied by strong winds, there is a considerable amount of drifting. As a result, wide, exposed areas may retain little or no snow and the more sheltered areas may be covered by deep drifts.

Daily measurement of the depth of snow in representative areas shows that a measurable snow cover (1 inch or more) is on the ground an average of about 70 days per winter. In cold, snowy winters, the number of days having a measurable snow cover exceeds 100, but in winters of light snow, mild temperatures, or both, the number is less than 50.

Other factors of climate

During the warm months, thunderstorms are often accompanied by damaging wind, hail, or both. Normally, one or two destructive hailstorms may be expected in some part of the county during the growing season. Tornadoes are infrequent. Blizzards occur in about one winter out of three, and freezing rains are about as frequent.

The prevailing wind is southerly from May through October and northwesterly the rest of the year. Winds tend to be lightest in July and August; those of highest velocities are to be expected in March, April, and May.

In summer the relative humidity averages between 45 and 50 during the afternoon. Consequently, hot days are not too uncomfortable.

There is an average of 105 clear days per year. Annually, about 12 clear days occur each month from July through October. There are about 120 partly cloudy and 140 cloudy days. Most of the cloudy days occur from November through March.

Native Vegetation

Hand County was once covered mainly by prairie grasses. There were also a few trees in stream bottoms and protected coves in hilly areas. On the well-drained, medium-textured soils of the uplands, the principal grasses were green needle grass, little bluestem, big bluestem, junegrass, side-oats grama, blue grama, and buffalograss. In addition, there were some sedges. Western wheatgrass was prevalent on some fine-textured soils and on soils in depressions that were flooded for short periods during the year. Saltgrass grew in areas that were salty or alkaline. Big bluestem, switchgrass, Indiangrass, and prairie cordgrass grew on the more moist sites. Little bluestem, big bluestem, prairie sandreed, blue grama, and sand dropseed were on the sandier soils.

Various forbs grew on the prairie. These included some native legumes, such as scurfpeas, vetches, and prairie clovers, that helped to maintain the supply of nitrogen in the soils.

Agricultural Statistics

Agricultural statistics for Hand County, as reported by the South Dakota Crop Reporting Service, are given in this section. The tenure of farms by operator is given in table 3, the acreages and yields of principal crops in table 4, and the approximate number of livestock on farms in table 5.

TABLE 3.--Farms by tenure of operator

Tenure	1945	1950	1954
	Number	Number	Number
All farms	1,220	1,168	1,093
Full owners	216	298	290
Part owners	552	530	533
Managers	8	6	-----
All tenants	444	334	270
Cash tenants	24	14	13
Share-cash tenants	135	202	164
Share tenants and croppers	283	94	84
Other and unspecified tenants	2	24	9

How Soils Are Named, Mapped, and Classified

Soil scientists made this survey to learn what kinds of soils are in Hand County, where they are located, and how they can be used.

They went into the county knowing they likely would find many soils they had already seen, and perhaps some they had not. As they traveled over the county, they observed steepness, length, and shape of slopes; size and speed of streams; kinds of native plants or crops; kinds of rock; and many facts about the soils. They dug or bored many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down to the rock material that has not been changed much by leaching or by roots of plants.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to uniform procedures. To use this report efficiently, it is necessary to know the kinds of groupings most used in a local soil classification.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have

TABLE 4.--Acreages and yields of principal crops in stated years

Crops	Acres harvested			Yield per acre			Production		
	1957	1958	Average (1941-1956)	1957	1958	Average (1941-1956)	1957	1958	Average (1941-1956)
				Bu.	Bu.	Bu.	Bu.	Bu.	Bu.
Corn, all	82,200	81,700	73,800	26.0	20.5	18.4	2,137,200	1,674,800	1,386,700
Wheat, all	42,800	55,800	78,600	16.3	25.1	7.1	695,800	1,400,200	853,800
Winter	3,200	9,900	1,600	26.0	39.5	7.0	83,200	391,000	21,100
Durum	2,400	1,000	2,200	15.0	21.4	10.1	36,000	21,400	21,300
Other spring	37,200	44,900	74,900	15.5	22.0	7.0	576,600	987,800	812,700
Oats	82,800	74,500	76,100	31.0	38.0	13.5	2,566,800	2,831,000	2,010,100
Barley	5,000	4,100	26,600	18.5	25.0	11.5	92,500	102,500	469,900
Rye (for grain)	2,500	4,400	9,800	14.5	24.0	6.5	36,200	105,600	106,100
Flaxseed	3,700	3,100	6,200	6.0	11.5	4.5	22,200	35,600	41,600
Sorghums, all	1/6,300	1/4,900	1/15,000	(2/)	(2/)	(2/)	(2/)	(2/)	(2/)
Alfalfa seed	3,000	(2/)	3/3,200	(2/)	(2/)	(2/)	(2/)	(2/)	(2/)
				Tons	Tons	Tons	Tons	Tons	Tons
Hay, all	219,600	190,700	170,600	1.16	.92	.70	254,600	175,800	117,600
Alfalfa	81,000	78,000	24,700	1.75	1.30	1.15	141,800	101,400	30,000
All other tame hay	-------	-------	8,700	----	----	.55	-------	-------	6,800
Wild hay	132,200	106,800	137,200	.80	.65	.60	105,800	69,400	80,900

1/ Acres planted, including that harvested for grain and forage.

2/ Not reported

3/ 1941-1955 average.

TABLE 5.--Approximate number of livestock on farms on January 1 of stated years

Year	All cattle	Cows and heifers 2 or more years old		Sheep and lambs	Horses and mules	Hogs
		Mainly for milk	Mainly for beef			
1940--	36,500	7,300	10,600	42,000	7,300	19,100
1945--	65,700	7,300	23,300	36,800	5,500	32,100
1950--	57,400	4,600	28,800	14,300	3,100	30,200
1955--	81,000	4,500	40,600	30,200	1,700	29,100
1956--	80,100	4,500	41,500	33,900	(1/)	30,600
1958--	77,100	4,300	37,100	39,900	(1/)	27,300

1/ Estimates not available.

major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Agar and Houdek, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in natural characteristics.

Many soil series contain soils that are alike except for texture of their surface layer. According to this difference in texture, separations called soil types are made. Within a series, all the soils having a surface layer of the same texture belong to one soil type. LaDelle silt loam and LaDelle silty clay loam are two soil types in the LaDelle series. The difference in texture of their surface layers is apparent from their names.

Some soil types vary so much in slope, degree of erosion, number and size of stones, or some other feature affecting their use, that practical suggestions about their management could not be made if they were shown on the soil map as one unit. Such soil types are divided into soil phases. The name of a soil phase indicates a feature that affects management. For example, Hand loam, nearly level, is one of two phases of Hand loam, a soil type that ranges from nearly level to undulating.

After a fairly detailed guide for classifying and naming the soils had been worked out, the soil scientists drew soil boundaries on aerial photographs. They used photos for their base map because these show buildings, field borders, trees, and similar detail that greatly help in drawing boundaries accurately. The detailed soil map in the back of this report was prepared from aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning management of farms and fields, a mapping unit is nearly equivalent to a soil type or a phase of a soil type. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered areas of soil of some other kind that have been seen within an area that is dominantly of a recognized soil type or soil phase.

In preparing some detailed maps, the soil scientist has a problem of delineating areas where different kinds of soils are so intricately mixed, and so small in area, that it is not practical to show them separately on the map. Therefore, he shows this mixture of soils as one mapping unit and calls it a soil complex. Ordinarily, a soil complex is named for the major soil series in it; for example, Bonilla-Houdek loams, nearly level.

Also, in most mapping, there are areas to be shown that are so rocky, so shallow, or so frequently worked by wind and water that they cannot be called soils. These areas are shown on a soil map like other mapping units, but they are given descriptive names, such as Rolling sandy land or Saline alluvial land, and are called land types rather than soils.

Some of the mapping units in Hand County consist of an association of several soils. An example is the Agar association.

Some soils have been mapped together as undifferentiated units, as Zahl and Sioux soils, hilly. An undifferentiated unit consists of two or more soils that are not regularly associated geographically but have been mapped together because their differences were too slight to justify separation.

Most of the mapping units in Hand County are made up of two or more soils. Additional map detail is not needed for dryland farming or for ranching, because the intermingled soils must be used as a single tract. A more detailed map is needed for irrigation purposes, however. Such a map was made of the northeastern quarter of the county and is on file in the office of the Soil Conservatior Service in Miller and at the Agronomy Department of South Dakota State College in Brookings.

Only part of the soil survey was done when the soil scientist had named and described the soil series and mapping units and had shown the location of the mapping units on the soil map. The mass of detailed information he had recorded then needed to be presented in different ways for different groups of users, among them farmers, managers of rangelands, and engineers.

To do this efficiently, he had to consult with persons in other fields of work and jointly prepare with them groupings that would be of practical value to different users. Such groupings are the capability classes, subclasses, and units, designed primarily for those interested in producing the short-lived crops and tame pasture; the range sites, for those using large tracts of native grass; and the classifications used by engineers who build highways or structures to conserve soil and water.

General Soil Map

After studying the soils in a locality and the way they are arranged, it is possible to make a general map that shows the main patterns of soils in different areas in the county. Such a map is the colored general soil map in the back of this report. The

general soil areas on this map are called soil associations. Each kind of general soil area, or association, as a rule, contains a few major soils and several minor soils in a pattern that is characteristic, although not strictly uniform.

The soils within any one association are likely to differ greatly among themselves in some properties; for example, slope, depth, stoniness, or natural drainage. Thus, the general map does not show the kind of soil at any particular place, but a pattern that has in it several kinds of different soils.

The soil associations are named for the major soil series in them, but, as already noted, soils of other series may also be present. The major soil series of one association may also be present in other associations, but in a different pattern and proportion.

The general soil map that shows the principal soils is useful to people who want a general idea of the soils, who want to compare different parts of a county, or who want to know the possible location of good-sized areas suitable for a certain kind of farming or other land use.

(1) *Houdek-Bonilla association: Nearly level to gently undulating loamy soils from glacial till*

This soil association is mostly in the northeastern and central parts of the county. It makes up about 32 percent of the acreage. The topography is mainly nearly level (fig. 5), but there are some low hills, and some depressions where runoff water collects. The narrow flood plains along streams are bordered by steep banks, many of which range from 10 to 30 feet in height.

The major soils in this association are the Houdek and Bonilla. The Houdek soils are permeable loams on well-drained knolls or gentle slopes. Their surface layer is dark colored and friable. These soils are underlain by slowly permeable glacial till.

The Bonilla soils are permeable loams in moderately well drained, nearly level areas and in

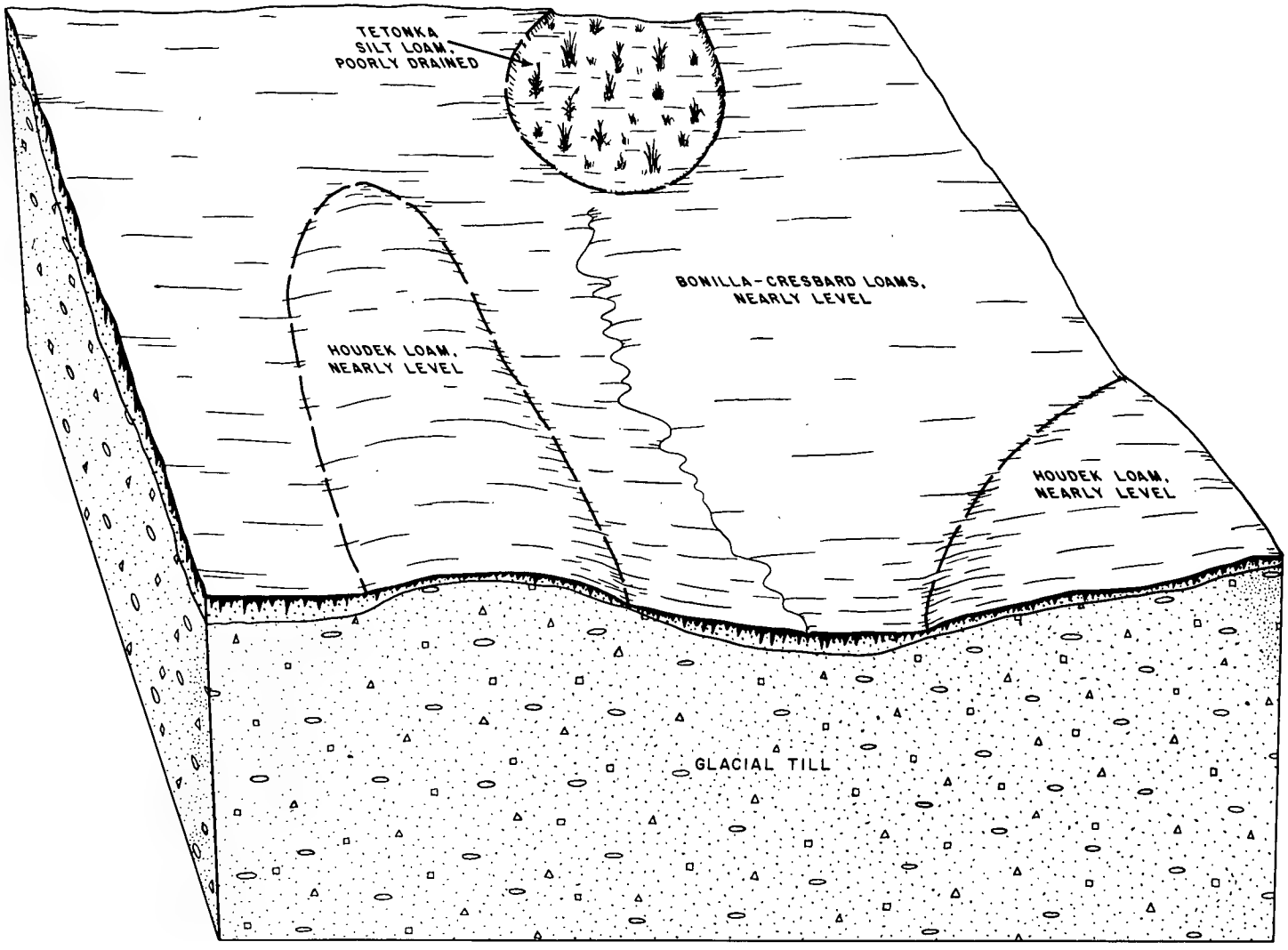

Figure 5.--A typical cross section of the northeastern part of Hand County.

drainageways. Their surface layer is thick, friable, and dark colored. These soils are underlain by slowly permeable glacial till of loam texture.

In some nearly level areas, there are Cresbard, Cavour, and Miranda soils, all of which contain a claypan. The Cresbard soils have a friable surface layer and a moderately compact claypan in the subsoil. The Cavour soils are similar to the Cresbard but have a more compact claypan. The Miranda soils have a claypan so near the surface that it becomes part of the plow layer when the soil is cultivated. All these claypan soils are likely to have poor tilth.

This association also includes minor areas of the Tetonka and LaDelle soils. The Tetonka soils are in depressions. The upper part of their subsoil is friable and dark colored; the lower part is a claypan. The LaDelle soils are common in stream valleys and on terraces or benches along valleys. These loamy soils are permeable and friable.

The Houdek, Bonilla, Cresbard, and LaDelle soils of this association are used to grow corn, small grain, and hay crops. The poorly drained Tetonka soils of the depressions and the poorly drained soils of the stream bottoms are used for pasture.

(2) *Houdek-Cavour-Miranda association: Nearly level to gently sloping loamy soils from glacial till; some soils contain claypan*

This soil association is mainly in the northeastern and central parts of the county. It makes up about 8 percent of the total area. Most of the area has a nearly level surface, but there are some low ridges and hills, depressions, and stream bottoms.

The major soils in this association are the Houdek, Cavour, and Miranda. The Houdek soils are on low knolls and gentle slopes. They consist of permeable loam that is underlain by a substratum of slowly permeable glacial till.

Unlike the Houdek soils, the Cavour and Miranda soils have a claypan and are slowly permeable. The claypan is below the plow layer in the Cavour soils but is within plow depth in the Miranda soils. These claypan soils generally occur in nearly level areas that collect runoff water from adjacent areas of Houdek soils.

Most nearly level areas of this association also contain Bonilla and Cresbard soils, and in many tracts too small to be shown on the general soil map, these are the dominant soils.

Areas made up mainly of the Houdek and Cavour soils are usually cultivated. Small grain, corn, and hay crops are grown. Areas that consist mainly of the Miranda soils are used as pasture because the plow layer of these soils is generally of poor tilth. Soils that occur in poorly drained depressions and in stream bottoms are used for pasture or for hay crops.

(3) *Hand association: Nearly level loamy soils from glacial melt water deposits*

This soil association occurs along the eastern boundary in the northern part of the county. It makes up nearly 2 percent of the total area. The topography is mainly nearly level, but there are some shallow depressions and narrow drainageways.

This association is made up mainly of Hand soils. These soils are moderately well drained to well drained. They are thick, friable, permeable, and loamy. Their surface layer is dark colored and fertile. The substratum consists of slowly permeable glacial till.

Minor soils in this association are the Tetonka, Houdek, and Bonilla. The Tetonka soils are in poorly drained depressions. The Houdek and Bonilla soils occur in places where the loamy outwash is very thin, or lacking, over glacial till.

The soils of this association are used for crops. Corn and small grain are grown. Because they are permeable, the Hand soils are suitable for irrigation.

(4) *Zahl association: Rolling to hilly soils from mixed materials*

This soil association occurs in all hilly parts of the county. Within the hilly areas, however, there are poorly drained depressions, narrow stream valleys, and gently sloping uplands. About 17 percent of the county is in this association.

The major soils in this association are the Zahl. These excessively drained soils have a thin, dark-colored surface layer. They have steep slopes and are susceptible to water erosion. Zahl soils have developed from glacial till that is generally loamy but is sandy and gravelly in some areas.

The Tetonka soils, which occur in poorly drained depressions, make up a minor part of this association. Other minor soils in the Zahl association depend on the part of the county in which a particular area occurs. These are mainly the Houdek soils in the northeastern and eastern parts; the Williams soils in the northwestern and south-central parts; and the Raber soils in the southwestern and southern parts.

The gently sloping areas of the uplands and along the narrow stream valleys can be cultivated. In general, however, areas of this association are used for pasture or hay.

(5) *Williams-Bonilla association: Nearly level to gently undulating soils from loam or coarse clay loam till*

This soil association is in the south-central and northwestern parts of the county. It makes up approximately 11 percent of the total area. The topography is mainly nearly level, but there are many shallow depressions, some narrow stream valleys, and a few low ridges and knolls.

The soils of this association are similar to those of the Houdek-Bonilla association, although they are not as deep. The climate of this association is drier than that of the Houdek-Bonilla.

The major soils of this association are the Williams and Bonilla. The well-drained Williams soils are on gentle slopes. These soils are permeable, but their substratum consists of slowly permeable glacial till. They have a dark-colored loamy surface layer that is underlain by a loamy or clayey subsoil.

The Bonilla soils are in drainageways. They have a thick, dark-colored loamy surface layer and friable loamy subsoil. Some areas of Cavour soils are in many of these drainageways. These soils have a claypan in the subsoil.

Also included in this association are the Hoven and the Tetonka soils. The Hoven soils, which have a claypan near the surface, are in shallow depressions. The Tetonka soils, which have a claypan in the subsoil, are in deeper depressions that collect more runoff water.

Soils of this association are used to grow small grain, hay, native grasses, and corn. Because of a less favorable climate, the soils are not so suitable for growing corn as those of the Houdek-Bonilla association. Consequently, on the Williams-Bonilla association, less acreage is in corn and more is in pasture and hay crops.

(6) Williams-Cavour-Miranda association: Nearly level to gently undulating loamy soils from clayey till; some soils contain claypan

This soil association is in the south-central and northwestern parts of the county (fig. 6). It covers about 12 percent of the total area. The topography is mainly nearly level to undulating, but there are many shallow depressions, some narrow stream valleys, and a few tracts that have low knolls.

The association is similar to the Williams-Bonilla, but most of the drainageways and nearly level areas contain Cavour and Miranda soils instead of Bonilla soils.

The major soils are the Williams, Cavour, and Miranda. The Williams soils are on well-drained slopes. They are similar to the Williams soils described in the Williams-Bonilla association. The Cavour soils have a friable, dark-colored loamy surface layer. They have a claypan below the plow layer. In the Miranda soils, the claypan is near the surface and within the plow layer. Consequently, the plow layer has poor tilth.

Minor soils in this association are the Hoven, Tetonka, LaDelle, Lamoure, and Zahl. The Hoven soils are in shallow depressions and have a claypan near the surface. The Tetonka soils are in depressions that collect more runoff water than those in which the Hoven soils occur. They have a friable, dark-colored surface layer and have a claypan in the subsoil. The LaDelle and Lamoure soils are in

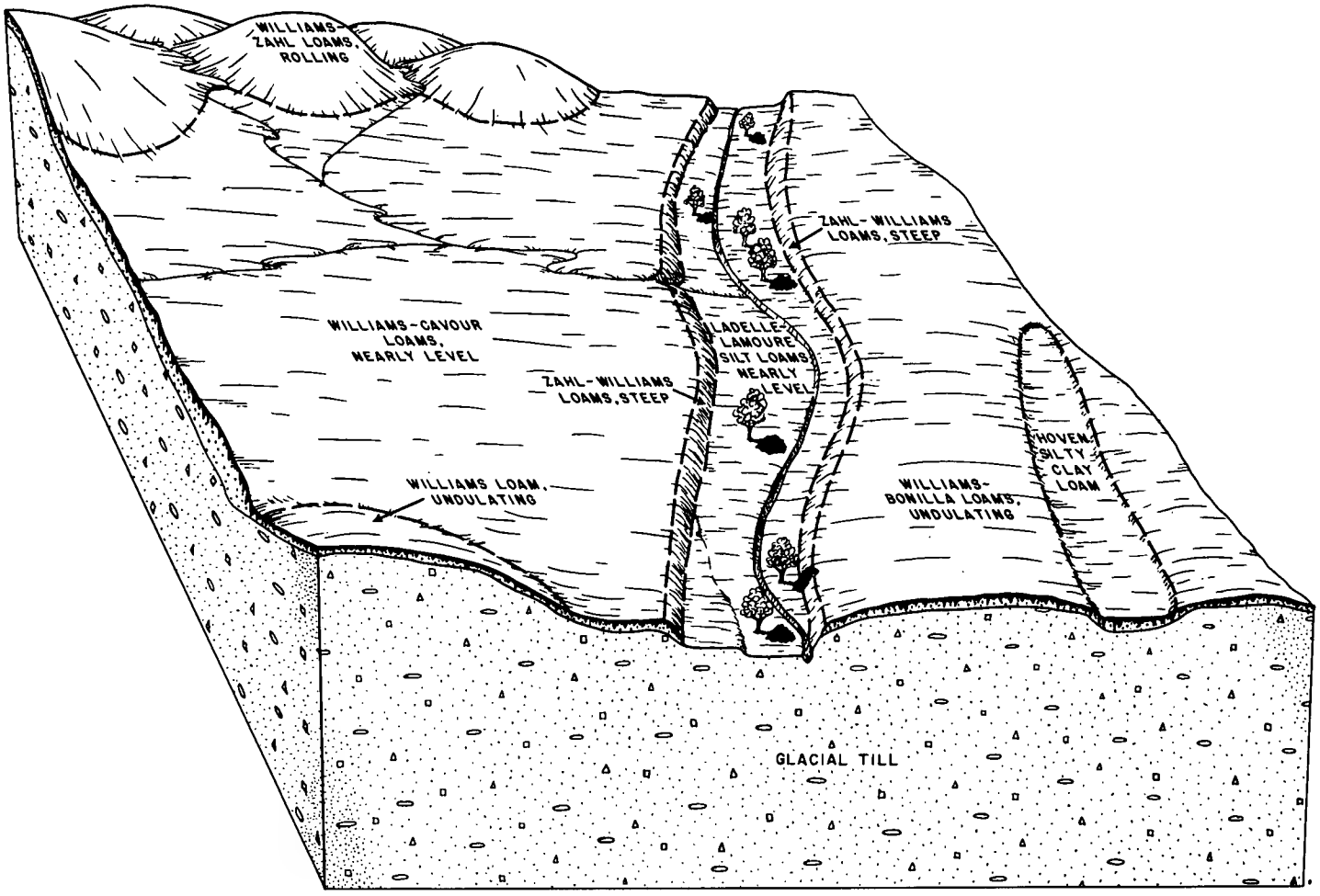

Figure 6.--A cross section typical in both the south-central and northwestern parts of Hand County.

stream valleys. They have friable loamy profiles. Zahl soils are in the rapidly eroding areas on steep banks along stream valleys. They have a thin, dark-colored surface layer. Williams soils are in the slowly eroding areas on these steep banks.

(7) Raber-Eakin association: Undulating and nearly level clay loam soils from loess and clayey till

This soil association is in the southern part of the county (fig. 7). It makes up nearly 8 percent of the total area. The topography is mainly undulating, but there are some depressions, low knolls, and narrow stream valleys. A few tracts are nearly level.

The major soils in this association are the Raber and Eakin. In general, the Raber soils are on well-drained knolls and gentle slopes, and the Eakin soils are in nearly level areas and in drainageways. The Raber soils have formed from glacial till, whereas the upper part of the profile of Eakin soils has formed from loess, and the lower part, from till. The Raber soils have a friable, dark-colored loamy surface layer; a slightly plastic clayey subsoil; and a slowly permeable substratum. The Eakin soils have a more friable surface layer and a more permeable subsoil than the Raber soils. Minor soils in this association are the Agar, Tetonka, and Hoven. The Agar soils occur in places where the mantle of loess is thick. They are similar to Eakin soils but have formed entirely from loess. The Tetonka and Hoven soils are in depressions. The Tetonka soils have a claypan in the subsoil, and the Hoven soils have a claypan near the surface.

Small grain, alfalfa, and corn, as well as native grasses for pasture or hay, are grown on the soils of this association. In general, cultivated areas are more nearly level and contain a greater proportion of Eakin soils than areas used for pasture.

(8) Raber-Eakin-Miranda-Cavour association: Undulating and nearly level soils from loess and clayey till; some soils contain claypan

This soil association is in the southern part of the county. It makes up approximately 6 percent

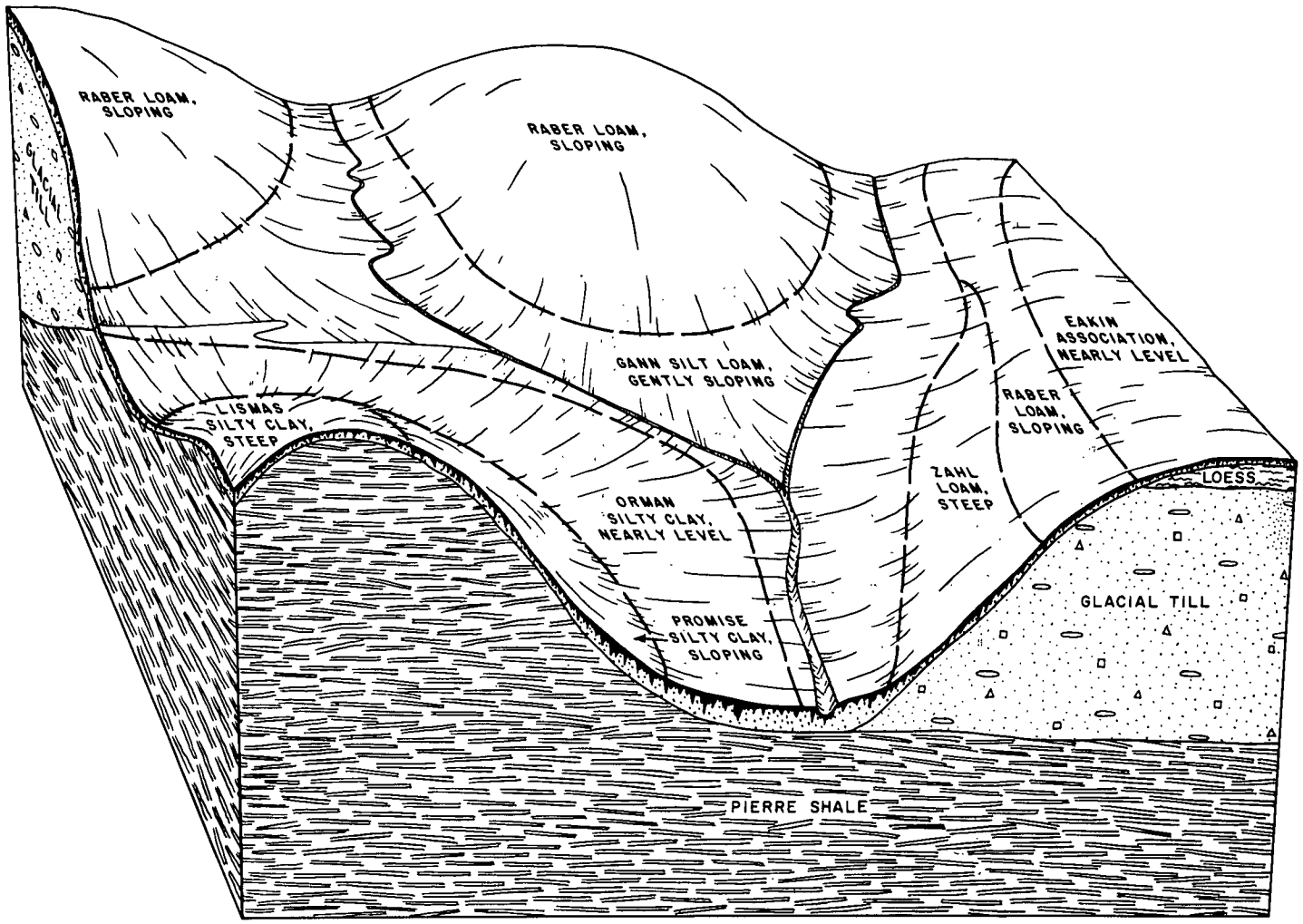

Figure 7.-- A typical cross section of the southwestern part of the county.

of the total area. The topography is mainly undulating to nearly level, but there are some depressions and narrow stream valleys.

The major soils in this association are the Raber, Eakin, Miranda, and Cavour. The Raber and Eakin soils are on well-drained slopes and low knolls. Characteristics of these soils are described under the Raber-Eakin association. The Miranda and Cavour soils are in nearly level areas and along drainageways in the uplands. The Miranda soils have a claypan near the surface, and the Cavour soils have a claypan below the depth to which they are generally plowed. The tilth of the surface layer becomes unfavorable if the claypan is incorporated into the plow layer through tillage.

Minor soils in this association are Tetonka and Hoven. These soils are in depressions. The Tetonka soils have a claypan in the subsoil, and the Hoven soils have a claypan near the surface.

Most nearly level and gently sloping areas of Raber, Eakin, and Cavour soils are used to grow small grain, alfalfa, and corn. Steep areas and areas where Miranda soils are extensive are used for hay or pasture.

(9) Sioux-Promise association: Hilly and steep soils underlain by gravel or shale

This soil association is in the valley of Elm Creek in the southwestern part of the county. It makes up less than 1 percent of the total area. The topography is dominantly hilly. Soils on the upper part of slopes have formed in gravel or glacial till, and those on the side slopes have formed in glacial till or shale.

The major soils in this association are the Sioux and Promise. The Sioux soils are on ridgetops. They are shallow to the underlying gravel. The Promise soils are on gentle slopes. They have formed in shale material and have a clayey profile.

Minor soils in this association are Lismas, Zahl, Raber, Orman, and Gann. The Lismas and Zahl soils are steep. The Lismas soils have formed from shale, and the Zahl, from glacial till. Both of these soils have a thin, dark-colored surface layer and are very susceptible to erosion. The clayey Lismas soils are shallow over shale. The Zahl soils are loamy. Gently sloping areas consist of the Raber soils, which have formed from glacial till, or of the Promise soils. The Orman and Gann soils are on gentle side slopes of valleys. The Orman soils are clayey, and the Gann soils are loamy or clayey.

Most of the areas of this association are too steep to be cultivated and are generally grazed. Soil in stream valleys can be cultivated, however.

Miscellaneous soils from water-deposited material

Four different associations consist of soils formed in water-deposited material. Together, they make up 3 percent of the county. A brief description of each of these associations follows.

(10a) Sioux-Oahe association: Gravelly, hilly soils in water-deposited material.--The major soils in this association, the Sioux and the Oahe, are gently sloping to rolling. They have formed in gravel deposited by glacial melt water. Both soils have dark-colored loamy surface layers. Gravel occurs at a depth of less than 20 inches in the Sioux soils and at a depth of more than 20 inches in the Oahe soils.

Gently sloping areas of this association are used to grow hay and small grain. Steeper areas are used for pasture.

(10b) McKenzie-Harriet-LaDelle association: Nearly level loamy soils that have silty clay loam or silty clay subsoil; some soils contain claypan.--This soil association is in the western part of the county. It consists mainly of the McKenzie, Harriet, and LaDelle soils. These soils are made up of alluvium deposited in a shallow marsh that has since been drained by Wolf Creek. The McKenzie soils are clayey, and their surface layer has poor tilth. These soils are used for hay or pasture. The Harriet soils have a claypan near the surface. They are also used for hay or pasture. The LaDelle soils have a fertile, friable loamy surface layer and a loamy or clayey subsoil. They are used for small grain, alfalfa, and corn.

(10c) Lane-Exline association: Gently sloping loamy soils and nearly level clayey soils that contain claypan.--This soil association occurs in the west-central part of the county. The gently sloping loamy Lane soils are in the southern part of the area, and the clayey Lane and Exline soils are in the northern part (fig. 8). The alluvial parent material of these soils washed from the Ree Hills to the gentle foot slopes.

The Lane soils are used to grow small grain, alfalfa, and corn. The large areas of Exline soils are used for hay or pasture.

(10d) Lane association: Gently sloping loamy soils from loamy material.--This association consists mostly of Lane soils. These soils have formed in material that washed from the Wessington Hills. Most areas are used to grow corn, small grain, and hay.

Descriptions of the Soils

Brief descriptions of each soil series and mapping unit in the county are given in this section. Most of the mapping units are made up of soils of more than one series. Consequently, after reading the description of a particular mapping unit, the reader probably will want to look up the series description of the different soils. For instance, he may first read what is said about the mapping unit, Bonilla-Houdek loams, nearly level. Then, for additional information, he can turn to the descriptions of the Bonilla series and the Houdek series.

The soil texture is part of the name of most of the mapping units in Hand County. An example is Bonilla-Cresbard loams, nearly level. In some mapping units the texture is variable, and additional soils would have been recognized if the scale of the map had been larger. An example is Eakin-Raber complex. In the soils of this complex, the thickness of loess ranges from 0 to 30 inches. In

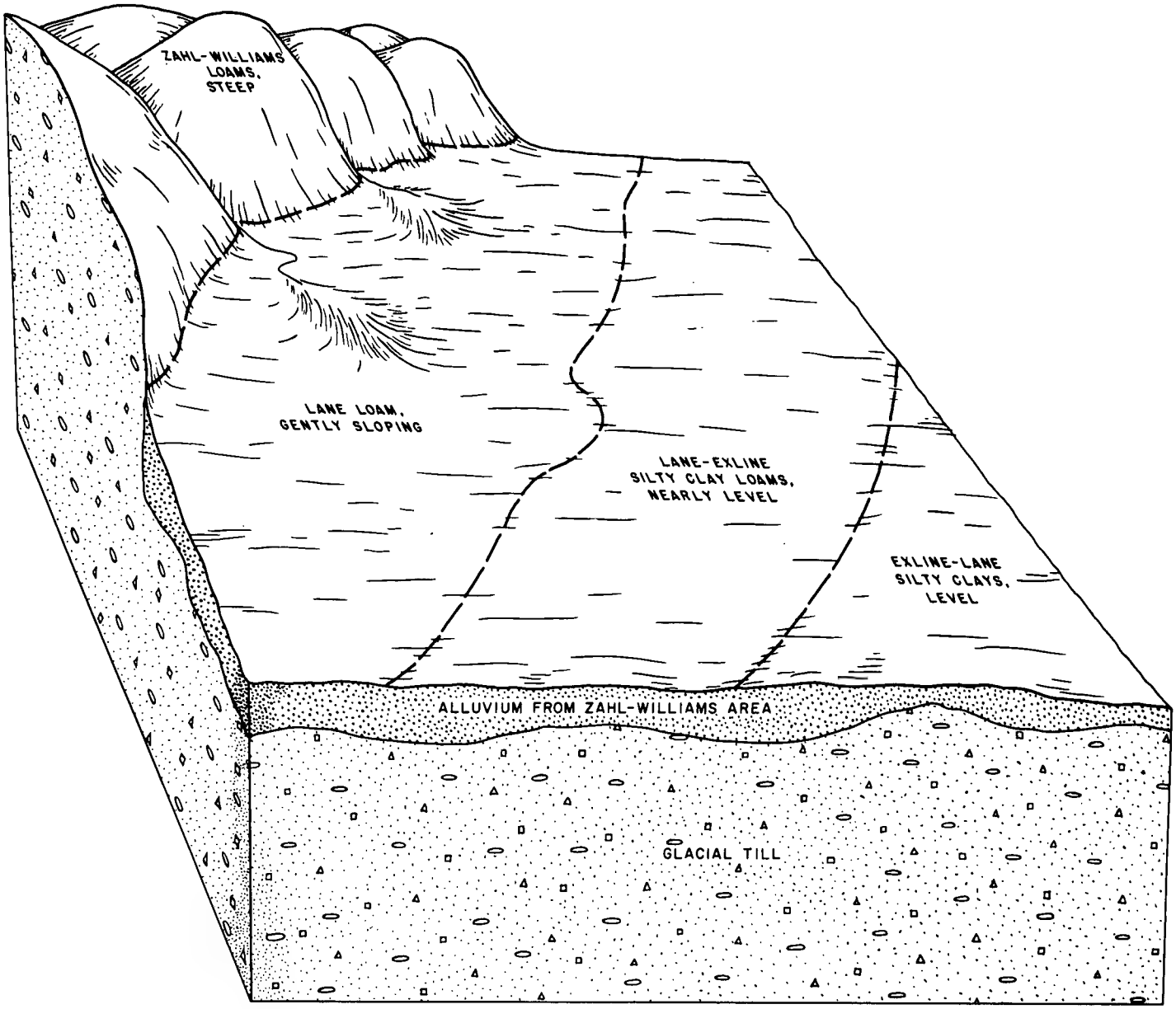

Figure 8.--A cross section typical of an area next to the Ree Hills or the Wessington Hills.

some areas the mantle of loess in which the Eakin soil has formed is 10 inches thick, but in others it is nearly 30 inches thick.

Information in this part of the report, together with the detailed soil map in the back, represents the basic data of the soil survey. Interpretations given throughout the report for agriculture, engineering, and other soil uses are based on this information.

The approximate acreage and proportionate extent of the soils mapped in the county are listed in table 6.

A more technical description of each soil series is given in the section "Genesis, Classification, and Morphology of the Soils." Additional information on management of the soils is given in the section "Use and Management of the Soils."

Aberdeen Series

The Aberdeen series consists of deep, nearly level soils that have a claypan below plow depth. These soils occur on stream terraces and are associated with the LaDelle soils. Most of the areas are too high above the streams to be flooded. The Aberdeen soils are used for cultivated crops and for pasture.

TABLE 6.--Approximate acreage and proportionate extent of the soils

Map symbol	Mapping unit	Area	Extent	Map symbol	Mapping unit	Area	Extent
		Acres	Percent			Acres	Percent
Ag	Agar association	1,742	0.2	HkA	Houdek-Bonilla loams, nearly level	73,240	8.0
BcA	Bonilla-Cresbard loams, nearly level	9,996	1.1	HkB	Houdek-Bonilla loams, undulating	87,413	9.5
BhA	Bonilla-Houdek loams, nearly level	17,385	1.9	HlA	Houdek-Cavour loams, nearly level	18,992	2.1
CaA	Cavour complex, nearly level	6,618	.7	HlB	Houdek-Cavour loams, undulating	15,397	1.7
CcA	Cavour-Cresbard silt loams, nearly level	1,312	.1	HmA	Houdek-Miranda complex, nearly level	877	.1
CeA	Cavour-Eakin complex, nearly level	595	.1	HmB	Houdek-Miranda complex, undulating	1,309	.1
ChA	Cavour-Houdek loams, nearly level	9,564	1.0	HsB	Houdek-Sioux complex, undulating	515	.1
ChB	Cavour-Houdek loams, undulating	585	.1	HsC	Houdek-Sioux complex, rolling	370	(1/)
CmA	Cavour-Raber silt loams, nearly level	1,223	.1	HsD	Houdek-Sioux complex, hilly	695	.1
CnA	Cavour-Williams loams, nearly level	6,518	.7	HtD	Houdek-Zahl complex, rolling	2,695	.3
CrA	Cresbard-Bonilla loams, nearly level	1,811	.2	HuD	Houdek-Zahl loams, rolling	11,911	1.3
CsA	Cresbard-Cavour silt loams, nearly level	4,221	.5	Hv	Hoven silty clay loam	23,991	2.6
EaA	Eakin association, nearly level	840	.1	HyA	Hurley-Orman silty clays, nearly level	710	.1
EaB	Eakin association, undulating	3,303	.4	LaA	LaDelle loam, nearly level	1,363	.1
EcA	Eakin-Cavour complex, nearly level	1,265	.1	LbA	LaDelle silt loam, nearly level	17,525	1.9
EcB	Eakin-Cavour complex, undulating	2,009	.2	LcA	LaDelle silty clay loam, nearly level	726	.1
EmA	Eakin-Miranda complex, nearly level	1,020	.1	LdA	LaDelle silty clay loam, fans, nearly level	5,430	.6
EmB	Eakin-Miranda complex, undulating	1,923	.2	LeA	LaDelle-Aberdeen silty clay loams, nearly level	9,679	1.0
ErA	Eakin-Raber complex, nearly level	481	.1	LlA	LaDelle-Lamoure silt loams, nearly level	7,468	.8
ErB	Eakin-Raber complex, undulating	14,206	1.5	LmA	Lamoure silty clay loam, nearly level	245	(1/)
EsA	Exline silty clay, level	2,956	.3	LnB	Lane loam, gently sloping	2,682	.3
EtA	Exline complex, nearly level	7,023	.8	LoA	Lane silty clay, nearly level	860	.1
EvA	Exline-Lane silty clay loams, nearly level	2,770	.3	LpA	Lane-Exline silty clay loams, nearly level	5,165	.6
ExA	Exline-Lane silty clays, level	1,895	.2	LrA	Lane-Exline silty clays, level	665	.1
GaA	Gann silt loam, nearly level	1,719	.2	LsA	Lane-Harriet silty clay loams, nearly level	1,679	.2
GaB	Gann silt loam, gently sloping	5,841	.6	LtD	Lismas-Promise silty clays, hilly	1,190	.1
HaA	Hamerly loam, nearly level	50	(1/)	Ma	Maddock sandy loam	795	.1
HbA	Hand loam, nearly level	8,067	.9	McA	McKenzie clay, level	2,575	.3
HbB	Hand loam, undulating	1,235	.1	MdA	Miranda complex, nearly level	5,079	.6
HcA	Harriet complex, nearly level	1,556	.2	MeA	Miranda-Eakin complex, nearly level	340	(1/)
HdA	Harriet-LaDelle silty clay loams, nearly level	1,857	.2	MhA	Miranda-Houdek complex, nearly level	1,440	.2
HeA	Harriet-Lane silty clay loams, nearly level	1,381	.1	MhB	Miranda-Houdek complex, undulating	886	.1
Hg	Hilly gravelly land	640	.1	MrA	Miranda-Raber complex, nearly level	1,273	.1
HhA	Houdek loam, nearly level	4,351	.5	MrB	Miranda-Raber complex, undulating	941	.1
HhB	Houdek loam, undulating	31,950	3.5				
HhC	Houdek loam, rolling	2,641	.3				

TABLE 6.--Approximate acreage and proportionate extent of the soils--Continued

Map symbol	Mapping unit	Area	Extent	Map symbol	Mapping unit	Area	Extent
		Acres	Percent			Acres	Percent
MwA	Miranda-Williams complex, nearly level	2,824	0.3	WgA	Wessington-Sioux loams, nearly level	685	0.1
MyB	Mondamin silty clay loam, gently sloping	551	.1	WgB	Wessington-Sioux loams, undulating	560	.1
OaA	Oahe loam, nearly level	661	.1	WmB	Williams loam, undulating	16,378	1.8
OaB	Oahe loam, undulating	885	.1	WmC	Williams loam, rolling	3,397	.4
OhA	Oahe-Sioux loams, nearly level	805	.1	WnA	Williams-Bonilla loams, nearly level	14,283	1.6
OhB	Oahe-Sioux loams, undulating	1,485	.2	WnB	Williams-Bonilla loams, undulating	65,995	7.2
OrA	Orman silty clay, nearly level	255	(1/)	WpA	Williams-Cavour loams, nearly level	32,578	3.5
OrB	Orman silty clay, gently sloping	1,778	.2	WpB	Williams-Cavour loams, undulating	37,519	4.1
PrB	Promise silty clay, gently sloping	215	(1/)	WrA	Williams-Eakin complex, undulating	405	(1/)
PrC	Promise silty clay, sloping	825	.1	WsA	Williams-Miranda complex, nearly level	1,382	.1
PrD	Promise silty clay, moderately steep	715	.1	WsB	Williams-Miranda complex, undulating	415	(1/)
RaA	Raber loam, nearly level	778	.1	WuB	Williams-Sioux complex, undulating	409	(1/)
RaB	Raber loam, undulating	15,477	1.7	WuC	Williams-Sioux complex, rolling	2,225	.2
RaC	Raber loam, rolling	5,586	.6	WuD	Williams-Sioux complex, hilly	560	(1/)
RcA	Raber-Cavour loams, nearly level	1,473	.2	WxC	Williams-Zahl complex, rolling	583	(1/)
RcB	Raber-Cavour loams, undulating	6,492	.7	WzC	Williams-Zahl loams, rolling	18,807	2.0
ReA	Raber-Eakin complex, nearly level	681	.1	ZaD	Zahl-Houdek complex, hilly	970	.1
ReB	Raber-Eakin complex, undulating	29,270	3.2	ZhD	Zahl-Houdek loams, hilly	4,443	.5
ReC	Raber-Eakin complex, rolling	3,899	.4	ZhE	Zahl-Houdek loams, steep	1,471	.2
RmA	Raber-Miranda complex, nearly level	846	.1	ZmD	Zahl-Raber complex, hilly	1,366	.1
RmB	Raber-Miranda complex, undulating	6,213	.7	ZmE	Zahl-Raber complex, steep	2,870	.3
RpC	Raber-Zahl complex, rolling	690	.1	ZrD	Zahl-Raber loams, hilly	16,532	1.8
RrC	Raber-Zahl loams, rolling	18,696	2.0	ZrE	Zahl-Raber loams, steep	7,550	.8
Rs	Rolling sandy land	635	.1	ZsD	Zahl and Sioux soils, hilly	1,730	.2
Ru	Rough broken land	2,620	.3	ZsE	Zahl and Sioux soils, steep	616	.1
Sa	Saline alluvial land	1,413	.1	ZxD	Zahl-Williams complex, hilly	940	.1
Sm	Sioux loam	1,991	.2	ZxE	Zahl-Williams complex, steep	960	.1
So	Sioux-Oahe loams	2,244	.2	ZyD	Zahl-Williams loams, hilly	8,901	1.0
Sw	Sioux-Wessington loams	1,315	.1	ZyE	Zahl-Williams loams, steep	8,906	1.0
SyA	Spottswood loam, nearly level	1,862	.2		Depressions shown by symbol	19,882	2.2
SxA	Spottswood complex, nearly level	620	.1		Gravel pits	20	(1/)
Tp	Tetonka silt loam, poorly drained	27,559	3.0		Lakes and dam ponds	2,775	.3
Tw	Tetonka silt loam, somewhat poorly drained	18,451	2.0		Swamps and intermittent ponds	11,274	1.2
WeA	Wessington loam, nearly level	2,243	.2		City of Miller	335	(1/)
WeB	Wessington loam, undulating	595	.1		Total	919,040	100.0

1/ Less than 0.1 percent of the county.

These moderately well drained to somewhat poorly drained soils are made up of alluvium. The surface layer is generally silty clay loam, but in some areas it is loam or silt loam. Beneath this is material that has a coarse silty clay loam to silt loam or loam texture. The subsoil, which begins at a depth of 9 inches, is made up mainly of very hard fine silty clay loam.

In Hand County the Aberdeen soils have been mapped only as part of LaDelle-Aberdeen silty

clay loams, nearly level. This mapping unit is described under the LaDelle series.

Agar Series

The Agar series consists of deep, dark-colored, nearly level, fertile soils. These soils are in the southern part of the county. Most areas are cultivated. Small grain, corn, grain sorghum, and alfalfa are grown.

The Agar are well-drained soils that have formed in loess that is at least 30 inches thick. The surface layer consists of dark-colored, granular, friable silt loam, 4 to 8 inches thick. It overlies a silty clay loam subsoil that has prismatic structure. The subsoil contains a layer in which there are white segregations of carbonate. The substratum in most places is glacial till of clay loam texture. This till is slowly permeable and contains salts and alkali; the upper soil layers, in contrast, are low in salts and alkali. In a few areas there is a layer of fine sand below the loess.

Agar association (Ag).--The soils of this mapping unit are mainly nearly level (0 to 2 percent slopes). Approximately 60 percent of the acreage is made up of Agar silt loam. Eakin silt loam generally makes up most of the rest, but Raber loam is also included.

The Agar soil has formed entirely in loess. Eakin silt loam, in contrast, has formed partly in loess, but the lower part has formed in glacial till. Raber loam has developed in a few areas where glacial till is at the surface.

The Agar soil is fertile and has no serious management problems. Bare areas need to be protected against wind erosion, however. On gentle slopes, terraces will retain moisture and reduce water erosion. A few areas of Agar soil collect runoff water from the adjacent higher slopes. Terraces on these slopes will protect the Agar soil from flooding and from gully erosion. Crops may respond to nitrogen and phosphate fertilizers. The need for fertilizers, as well as the amounts needed, should be determined by soil tests.

Management problems on the Eakin soil are similar to those of the Agar soil. (Capability unit IIc-2; Silty range site)

Bonilla Series

The Bonilla series consists of deep, dark-colored, fertile soils. The soils are mainly in the central and northern parts of the county, where they occur in nearly level areas, in sags between slight rises, and along small drainageways. Most areas are cultivated. Corn, small grain, and alfalfa are grown.

Bonilla soils are moderately well drained. Some areas have very little runoff; other areas collect runoff water from adjacent rises.

The surface layer of these soils is dark, friable loam, 6 to 10 inches thick. It has granular structure. In nearly level areas of the uplands, the parent material is loam glacial till. In sags and drainageways, it is loamy alluvium that washed from adjacent slopes. This parent material is friable and generally is slightly to moderately saline. In many drainageways, it consists of alternate dark- and light-colored layers. The dark-colored layers are old surface layers that were buried by material deposited by water.

In nearly level areas of the uplands in the eastern part of the county, the Bonilla soils are darker colored and thicker than in similar areas in the western part, where there is less rainfall. Because of the lower rainfall, crops grown in the western part yield less.

Bonilla-Cresbard loams, nearly level (BcA) (0 to 2 percent slopes).--About 60 to 80 percent of this complex is Bonilla loam, and 20 to 40 percent, Cresbard loam. Also, there are minor areas of Houdek soil on the low knolls, of Tetonka soil in the depressions, and of Cavour soil in other low areas.

The main soils, the Bonilla and Cresbard, are fertile and have no serious management problems. Nevertheless, grassed waterways are needed in some drainageways to retard gully erosion. Wind erosion may occur during long droughts, unless the surface is protected by vegetation.

The soils of this complex remain moist longer than the adjacent well-drained soils. Thus, if they are cultivated at the same time as the well-drained soils, they may be so wet that the surface layer puddles and has unfavorable structure when it dries. The Cresbard soil is slightly less productive than the Bonilla, because it has a moderately compact claypan in the subsoil.

On soils of this complex, corn grows better in the more humid eastern part of the county than in the drier parts to the west. (Capability unit IIc-2; Silty range site)

Bonilla-Houdek loams, nearly level (BhA) (0 to 2 percent slopes).--Soils of this complex occur mainly in the northeastern part of the county. Bonilla loam makes up 50 to 70 percent of the acreage, and Houdek loam makes up most of the rest. The Bonilla soil is in nearly level areas or drainageways between low, well-drained knolls of Houdek soil. Minor areas of Cresbard, Cavour, and Tetonka soils are also in this complex.

The soils of this complex are fertile and have no serious management problems. If soil-depleting crops are grown continuously for a number of years, however, nitrogen and phosphate fertilizer may be needed. Wind erosion may be severe on bare fields, but it can be controlled by stubble-mulch tillage. Stubble mulching will also help to control water erosion on low knolls of Houdek loam. Grassed waterways are needed in a few drainageways to prevent the formation of gullies.

Bonilla-Houdek loams, nearly level, are used to grow corn and small grain. Bonilla loam is more productive than Houdek loam because it retains more precipitation and collects runoff from the Houdek soil. It is, however, more likely to remain too wet for tillage longer than the Houdek soil. If the Bonilla soil is tilled when wet, the structure of the surface layer will be damaged. (Capability unit IIc-2; Silty range site)

Cavour Series

The Cavour series consists of deep, dark-colored soils that occur throughout the county. These soils have a claypan in the subsoil. Because the claypan restricts the growth of roots, many areas are used for pasture. With careful management, however, small grain and alfalfa can be grown.

In upland drainageways the Cavour soils have formed from a mixture of glacial till, loess, and alluvium. In other places they have formed from thin deposits of loess and alluvium over glacial till. Cavour soils are dominantly moderately well drained. Their surface layer is made up of friable, granular, dark-colored loam or silt loam, 4 to 10 inches thick. This is underlain by a friable, platy, grayish subsoil that is 3 to 6 inches thick. At a depth of 7 to 16 inches, there is a slowly permeable, silty claypan that has dense columnar structure. The lower part of the claypan and the substratum are moderately or highly saline, and in many places they are splotched with salts and carbonates.

Cavour complex, nearly level (CaA) (0 to 2 percent slopes).--About 50 to 70 percent of this complex is Cavour soil. Cresbard soil is also extensive in this complex. In addition, there are minor areas of Miranda soil that have little vegetation.

The main soil, the Cavour, is moderately fertile and has good tilth. When the soil is cultivated, the plowshare should be kept above the claypan. The surface layer will puddle if the soil is tilled when too wet. Normally, erosion is not a problem. In some nearly level areas, surface drains are needed to remove excess water.

Because of a more favorable climate, areas of this complex in the northeastern part of the county are slightly more productive than those in the western and southwestern parts. Small grain and deep-rooted legumes are not so adversely affected by the claypan as is corn. (Capability unit IVs-91; Silty range site)

Cavour-Cresbard silt loams, nearly level (CcA) (0 to 2 percent slopes).--The soils of this complex are in the southwestern part of the county and also along the southern boundary. They occur in drainageways and have formed mainly from material deposited by water. From 50 to 70 percent of this complex is Cavour silt loam. The rest is about evenly divided between the Cresbard soil and a dark-colored soil that is similar to the Gann soils.

Most areas collect runoff from adjacent slopes. Some of these slopes may need terraces that will divert runoff water. In some areas drainage ditches are needed to remove excess water.

This soil complex is used and managed in about the same way as Cavour complex, nearly level. Crops grown on it produce higher yields, however. (Capability unit IVs-91; Silty range site)

Cavour-Eakin complex, nearly level (CeA) (0 to 2 percent slopes).--This complex of soils occurs in the southwestern part of the county and also along the southern boundary. About 60 percent of it is Cavour silt loam. Most of the rest consists of Eakin silt loam, but there are generally a few very small tracts of Raber loam in places where the glacial till lacks a cover of loess. In addition, there are small spots of Miranda and Cresbard soils.

The surface layer of the Cavour soil has formed from loess or alluvium, and the claypan, from glacial till.

This soil complex is used and managed in about the same way as Cavour complex, nearly level. Because of the Eakin soil, however, it is slightly more productive. The Eakin soil is mainly on low gently sloping rises, and, therefore, water erosion can become a problem. Stubble-mulch tillage will help to control erosion. (Capability unit IVs-91; Silty range site)

Cavour-Houdek loams, nearly level (ChA) (0 to 2 percent slopes).--This complex of soils is in the central, eastern, and northeastern parts of the county. About 50 percent of it consists of Cavour loam, and 30 to 40 percent, Houdek loam. The remaining 10 to 20 percent consists of Bonilla, Cresbard, and Tetonka soils.

The Cavour soil occurs in sags and drainageways between low knolls of Houdek loam.

In general, the soils of this complex are used and managed in about the same way as Cavour complex, nearly level. Because it occurs on low knolls, Houdek loam is more susceptible to wind and water erosion than Cavour loam. Special practices, such as stubble-mulch tillage, are needed to prevent loss of surface soil.

Small grain and hay crops are more suitable than corn for the soils of this complex. (Capability unit IVs-91; Silty range site)

Cavour-Houdek loams, undulating (ChB) (3 to 5 percent slopes).--Except for gentle slopes and greater susceptibility to erosion, the soils of this complex are similar to those of Cavour-Houdek loams, nearly level. (Capability unit IVs-91; Silty range site)

Cavour-Raber silt loams, nearly level (CmA) (0 to 2 percent slopes).--This complex of soils occurs in the southwestern part of the county and along the southern boundary. Nearly 60 percent of it is Cavour silt loam, and 40 percent, Raber silt loam and loam. Most areas contain small spots of Miranda, Eakin, or Cresbard soils.

Most of the Cavour soil is in nearly level areas, either on low knolls or along drainageways. The Raber soil is on gentle slopes.

The management of this complex of soils is based mainly on the needs of the Cavour soil. Nevertheless, the Raber soil should be protected against water erosion. Stubble-mulch tillage will help to protect the Raber soil and also help to maintain a friable surface layer in Cavour silt loam. (Capability unit IVs-91; Silty range site)

Cavour-Williams loams, nearly level (CnA) (0 to 2 percent slopes).--This complex of soils is in the northwestern and south-central parts of the county. Nearly 50 percent of it is Cavour loam; 30 to 40 percent, Williams loam; and 10 to 20 percent, Bonilla, Cresbard, and Tetonka soils.

Most of Cavour loam is in nearly level areas along drainageways and on flat-topped knolls. The Williams soil is on slopes and is subject to erosion. Stubble-mulch tillage will help to control erosion on these slopes. (Capability unit IVs-91; Silty range site)

Cresbard Series

The Cresbard series consists of deep, dark-colored soils that have a moderately compact claypan in their subsoil. These soils occur in all parts of the county. Large areas usually are cultivated.

The Cresbard are moderately well drained soils that have developed in glacial till, loess, or alluvium along drainageways and in nearly level areas. The dark-colored, friable silt loam surface layer is 6 to 10 inches thick and has granular structure. Below this is a layer of friable, grayish silt loam that has weak, platy structure. A moderately compact claypan of clay loam or silty clay loam texture occurs about 10 to 14 inches below the surface. The claypan has prismatic and subangular blocky structure. It restricts the penetration and spread of roots, particularly during droughts when subsoil moisture is needed by plants.

The soil normally is nonsaline to a depth of 5 feet, but it may be saline below this depth. The substratum generally is slowly permeable.

Cresbard-Bonilla loams, nearly level (CrA) (0 to 2 percent slopes).--This complex of soils is in the northern half and the south-central and eastern parts of the county. Most of the areas are along drainageways. About 50 percent of this complex is Cresbard loam; 35 percent, Bonilla loam; and 15 percent, Cavour or other soils.

The Cresbard soil is fertile and has good tilth. It has no serious management problems, but some areas may need to be protected against runoff from adjacent slopes. A few areas in drainageways need grassed waterways to control gully erosion. The Cresbard soil has formed in moist sites. Cultivation should be avoided, when the soil is too wet, as the structure of the surface layer may be damaged.

Small grain, alfalfa, and corn are grown on soils of this complex. Crops grown in areas in the more humid northeastern part of the county produce the highest yields. (Capability unit IIIs-9; Silty range site)

Cresbard-Cavour silt loams, nearly level (CsA) (0 to 2 percent slopes).--This complex of soils is in the southwestern part of the county and along the southern boundary. The areas are in drainageways and also in small depressions in which natural drainage outlets have formed. Only about 30 percent of this complex consists of Cresbard silt loam, which has a moderately compact claypan. Approximately 50 percent is made up of friable soils that have some characteristics of a claypan but lack a moderately compact layer. The rest of the complex consists of Cavour silt loam.

This complex of soils is used and managed in about the same way as Cresbard-Bonilla loams, nearly level. Some areas that have a temporarily high water table could be made more productive by artificial drainage. (Capability unit IIIs-9; Silty range site)

Eakin Series

The Eakin series consists of deep, dark-colored, fertile soils. These soils are mainly in the southern part of the county, but a small area is in the northwestern part. Most nearly level and undulating areas are cultivated, and steeper areas are used for pasture.

The Eakin soils are well drained. The upper part of their profile is like that of the Agar soils. It has formed in loess that is less than 30 inches thick and is nearly free of pebbles. The lower part of the profile normally has formed in glacial till of clay loam texture. The till contains pebbles. The surface soil consists of 3 to 6 inches of dark-colored, friable silt loam with granular structure. The subsoil of silty clay loam or clay loam has prismatic structure and contains a zone splotched with segregations of white carbonate. The substratum is slowly permeable. It contains salts and alkali.

Eakin association, nearly level (EaA) (0 to 2 percent slopes).--This mapping unit is in the southern part of the county. Approximately 80 percent consists of Eakin silt loam, and 20 percent consists of Agar silt loam, Raber loam, and Cresbard silt loam.

Eakin association, nearly level, has no serious management problems, but wind erosion may damage fields that lack a protective cover. Most areas are used to grow small grain, corn, and alfalfa. (Capability unit IIc-2; Silty range site)

Eakin association, undulating (EaB) (3 to 5 percent slopes).--Except that they have short, gentle slopes, the soils of this mapping unit are similar to those of Eakin association, nearly level. Stubble-mulch tillage is needed to conserve water and to control erosion. (Capability unit IIe-2; Silty range site)

Eakin-Cavour complex, nearly level (EcA) (0 to 2 percent slopes).--This complex of soils is in the southern part of the county. Eakin silt loam makes up approximately 60 percent of the complex; Cavour silt loam, 25 to 30 percent; and Raber, Miranda, and Agar soils, 10 to 15 percent. In general, Eakin silt loam is more sloping than the Cavour soil.

In many places, the friable upper layers of the Cavour soil have formed from loess, and the underlying claypan, from glacial till. Some areas of the Cavour soil could be improved by surface drainage.

Most areas of this complex are cultivated. Small grain and alfalfa are usually grown instead of corn, because the claypan in the Cavour soil restricts the amount of moisture that is available to crops. (Capability unit IIIs-9; Silty range site)

Eakin-Cavour complex, undulating (EcB) (3 to 5 percent slopes).--This complex of soils is similar to Eakin-Cavour complex, nearly level, but it is more sloping. As a result, water erosion and the conservation of moisture may be problems. (Capability unit IIIe-9; Silty range site)

Eakin-Miranda complex, nearly level (EmA) (0 to 2 percent slopes).--This complex of soils is in the southern part of the county. Approximately 60 to 70 percent of it is Eakin silt loam; 20 percent, Miranda silt loam; and 10 to 20 percent, Cavour, Cresbard, and Raber soils.

Fields should not be cultivated until the Miranda soil is dry enough so that it will not puddle. Some areas could be improved by surface drainage. The claypan is in the plow layer of the Miranda

soil. Consequently, this layer has unfavorable structure.

Large areas of Eakin-Miranda complex, nearly level, probably should be used for pasture or for hay crops. Many areas are small, and these are managed in the same way as the rest of the field in which they occur. (Capability unit IVs-91; Silty range site)

Eakin-Miranda complex, undulating (EmB) (3 to 5 percent slopes).--This complex of soils is similar to the complex just described, except that the Eakin soil is gently sloping and is susceptible to erosion. Stubble-mulch tillage will help to prevent loss of soil by erosion. (Capability unit IVs-91; Silty range site)

Eakin-Raber complex, nearly level (ErA) (0 to 2 percent slopes).--This complex of soils is in the southern part of the county. About 60 to 80 percent of it is Eakin silt loam, and 20 to 40 percent, Raber loam. Most areas also have small tracts of Agar and Cresbard soils. The Raber soil is on low knolls and on short slopes.

Although the Raber soil is not so friable or productive as the Eakin, both soils need similar management. Wind erosion may be a problem on bare fields. It can be controlled if crop residues are maintained on the surface by stubble-mulch tillage.

Most areas of this complex are used to grow small grain, corn, and alfalfa. (Capability unit IIc-2; Silty range site)

Eakin-Raber complex, undulating (ErB) (3 to 5 percent slopes).--This complex of soils is similar to Eakin-Raber complex, nearly level, except that it has more short, gentle slopes that are subject to erosion. Because the slopes are short and irregular, contouring and terracing are not practical in most areas. Stubble-mulch tillage will help control water and wind erosion, however.

Areas that have many short, steep slopes are best used for hay crops or pasture. But in most areas small grain, corn, and alfalfa are grown. Some of these areas should be fertilized with nitrogen and possibly phosphate. Fertilizer rates should be determined by soil tests. (Capability unit IIe-2; Silty range site)

Exline Series

The Exline series consists of deep, dark-colored soils that have a claypan near the surface. These soils are in nearly level areas in the central and eastern parts of the county.

The Exline are poorly drained to moderately well drained soils that have formed in medium textured, moderately fine textured, and fine textured alluvium. They have a friable surface layer, a few inches thick, over a dense claypan that has columnar structure. Their substratum is either alluvium, which ranges from gravel to clay, or glacial till. In most places the substratum contains much salt and alkali.

Exline silty clay, level (EsA) (0 to 1 percent slopes).--Most areas of this soil are adjacent to the Ree Hills and the Wessington Hills. The soil is somewhat poorly drained. It has formed from silty clay deposited by small streams. The silty surface layer, which is over a claypan, is 1 to 6 inches thick. Plowing mixes the surface layer with the claypan. As a result, the plow layer has unfavorable structure, particularly if the soil is too wet when tilled.

Areas that have adequate surface drainage are being farmed successfully, but tillage can be done only when the soil is dry. Winter wheat is one of the most suitable crops, because the soil can be tilled during the drier part of the year. (Capability unit VIs-91; Panspots range site)

Exline complex, nearly level (EtA) (0 to 2 percent slopes).--This complex of soils is on stream benches and bottom lands in the central and northeastern parts of the county. The soils have formed from alluvium of silty clay loam or clay loam texture. Exline soil makes up about 50 percent of this complex; LaDelle soil, about 25 percent; and Aberdeen, Lamoure, and a saline soil, about 25 percent. Most areas have an uneven surface and contain many small, nearly barren depressions in which water collects.

In general, the areas of this complex lack adequate surface drainage and they are used for pasture or hay. The Exline soil has only about an inch of friable surface soil over a claypan. Unless grazing is controlled, wind erosion will remove this thin layer and forage production will decline. (Capability unit VIs-91; Panspots range site)

Exline-Lane silty clay loams, nearly level (EvA) (0 to 2 percent slopes).--Much of this complex of soils is adjacent to areas of Exline silty clay, level. In general, this complex has better surface drainage. About 60 percent of it is Exline soil, and 40 percent is Lane. Lane silty clay loam is deep and dark colored, and it lacks a claypan.

Stubble-mulch tillage helps to control wind erosion during winter and spring. Winter wheat, grain sorghum, and alfalfa are the common crops. (Capability unit IVs-91; Panspots range site)

Exline-Lane silty clays, level (ExA) (0 to 1 percent slopes).--Most areas of this complex are interspersed with areas of Exline silty clay, level. Exline soil generally makes up most of the complex, but Lane silty clay makes up 30 to 50 percent. The Lane soil lacks a claypan. It produces good yields if the surface layer does not become puddled. Consequently, this complex of Exline and Lane soils is more productive than Exline silty clay, level.

In winter and spring, wind erosion is generally severe in bare fields. It can be reduced if crop residues are maintained on and in the surface soil by stubble-mulch tillage. (Capability unit IVs-91; Panspots range site)

Gann Series

The Gann series consists of deep, dark-colored, friable soils that are nearly level to gently sloping. These soils are in the southern and northwestern parts of the county. Large areas are used to grow small grain, corn, and alfalfa.

The Gann are well drained to moderately well drained soils that have formed in alluvium washed

from adjacent hilly and steep areas (fig. 9). Because the parent material has been deposited intermittently over former dark-colored surface layers, the soil profile, in many places, consists of alternate light- and dark-colored layers.

The present surface layer is dark colored, friable, and 6 to 8 inches thick. It is generally silt loam, but it ranges from loam, in a few places near steep slopes, to silty clay loam, in places farther from the steep slopes. The subsoil and substratum are generally loam or silty clay loam, but in places they contain sandy material. The substratum is either alluvium or glacial till. In many places along Elm Creek, the profile is made up of silty clay loam.

The Gann soils are fertile and generally have good tilth. Because runoff from adjacent slopes collects on these soils, additional water is available to plants. Small gullies have formed in some areas where runoff water concentrates, however.

Gann silt loam, nearly level (GaA) (0 to 2 percent slopes).--This soil is fertile and has no serious management problems. Nevertheless, wind erosion may occur if fields are left bare. Loss of soil can be reduced if a protective cover is maintained by stubble-mulch tillage. Other management requirements on this soil are the conservation of water that comes from higher slopes, the control of sheet and gully erosion, and the maintenance of organic matter and nitrogen. Grassed waterways, contour farming, and the inclusion of a legume in the cropping system will help to make the soil more productive.

Small grain, corn, and alfalfa are grown on this soil. (Capability unit IIc-2; Silty range site)

Gann silt loam, gently sloping (GaB) (3 to 5 percent slopes).--This soil is similar to Gann silt loam, nearly level, except that it is more sloping. As a result, water erosion is more of a problem. Most areas are long enough for practical use of contour farming and terracing. (Capability unit IIe-2; Silty range site)

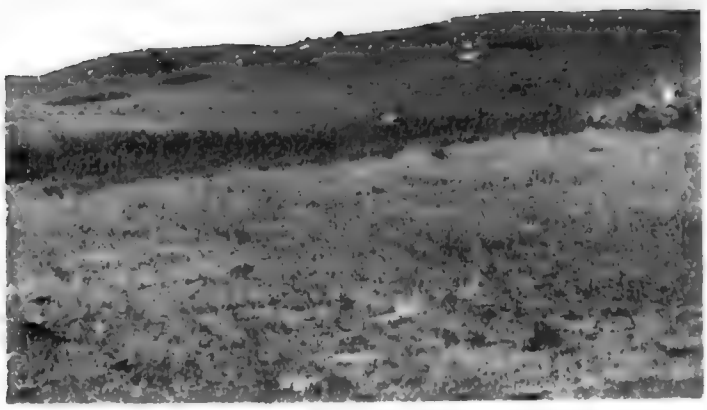

Figure 9.--The gently sloping Gann soils in the foreground have formed in material washed from the hilly Zahl soils in the background.

Hamerly Series

The Hamerly series consists of deep, dark-colored, nearly level soils that may have a seasonally high water table. These soils are in the northeastern part of the county.

The Hamerly are somewhat poorly drained soils that have formed in glacial till of a loam texture. They contain an excessive amount of lime (mainly calcium carbonate). The surface layer is dark colored, granular, and 4 to 8 inches thick. The subsoil is generally grayish colored. Part of it is within the plow layer.

The high content of lime in these soils interferes with the development of roots and the absorption of some plant nutrients. The amount of phosphorus available to plants is probably very low.

Hamerly loam, nearly level (HaA) (0 to 2 percent slopes).--Only a few areas of this soil have been mapped separately in the county. Most areas are very small and have been included in other mapping units. Because all the areas are small, this soil is managed in the same way as the soils with which it occurs. (Capability unit IVw-9; Silty range site)

Hand Series

The Hand series consists of deep, dark-colored, friable soils that are nearly level to undulating. These soils are in the northeastern quarter of the county, particularly in Burdette Township. Most areas are cultivated. Corn, small grain, and alfalfa are grown.

The Hand are well drained to moderately well drained soils that have formed in medium-textured material deposited by glacial melt water. They are practically free of stones and gravel. The surface layer is dark, friable loam or silt loam, 6 to 8 inches thick. It has granular structure. The loam or silt loam subsoil has prismatic structure. The upper part of the profile is almost free of salts, but the substratum of slowly permeable glacial till is saline.

These soils are fertile and have good tilth. They are very permeable and are suitable for irrigation.

Hand loam, nearly level (HbA) (0 to 2 percent slopes).--This soil has no serious management problems. (Capability unit IIc-2; Silty range site)

Hand loam, undulating (HbB) (3 to 5 percent slopes).--This soil is similar to Hand loam, nearly level, but it has many short, gentle slopes that are subject to erosion. Stubble-mulch tillage will control water erosion and reduce wind erosion on these slopes. (Capability unit IIe-2; Silty range site)

Harriet Series

The Harriet series consists of nearly level soils that have a claypan near the surface and a salty subsoil. They are in the western and southern parts of the county. Most areas are used for pasture.

These soils have formed from material deposited by small streams. They are somewhat poorly

drained to poorly drained, and many areas are wet in spring. The thin, friable surface layer overlies a dense, columnar claypan. In most places the subsoil and substratum are salty.

Harriet complex, nearly level (HcA) (0 to 2 percent slopes).--Most of the areas of this complex are along Elm and Crow Creeks and are somewhat poorly drained to poorly drained. Areas in the following locations are poorly drained and contain salty soils along with the Harriet soil: Secs. 24, 25, and 36, T. 109 N., R. 69 W.; secs. 18, 19, and 31, T. 109 N., R. 68 W.; and sec. 2, T. 109 N., R. 67 W.

The soils of this complex have developed from silty clay loam or silty clay that was deposited by streams. In at least 70 percent of the complex, the claypan of the Harriet soil is at or near the surface. In most areas of this complex, there is Lane soil, as well as a soil with a claypan about 6 inches below the surface.

The areas of this complex have uneven topography, and, consequently, they are used for pasture or hay. If grazing is not controlled, the more productive grasses will be destroyed. (Capability unit VIs-91; Panspots range site)

Harriet-LaDelle silty clay loams, nearly level (HdA) (0 to 2 percent slopes).--This complex of soils is in the south-central and northwestern parts of the county. The soils have formed from loam and silty clay loam that were deposited by streams. They occur in bottom lands, on low benches, and in large level areas along Wolf Creek near the western boundary of the county. About 50 percent of the complex is Harriet soil; 25 percent, LaDelle soil; and 25 percent, Aberdeen and Lamoure soils.

The Harriet soil has less than an inch of surface soil over a claypan. The cover of vegetation is uneven and in many places is absent. In most areas the substratum is moderately to strongly saline and may contain strata of sand and gravel.

The soils of this complex are used mainly for pasture and hay. (Capability unit VIs-91; Overflow range site)

Harriet-Lane silty clay loams, nearly level (HeA) (0 to 2 percent slopes).--This complex of soils is along streams in the southern part of the county. Approximately 60 percent of it is Harriet soil, and 40 percent is Lane. The soils are somewhat poorly drained, and they are used for pasture. This complex is similar to Harriet complex, nearly level, except that it contains a larger proportion of Lane soil, and, consequently, yields of forage are higher (fig. 10). (Capability unit VIs-91; Overflow range site)

Hilly Gravelly Land

Hilly gravelly land (Hg).--This miscellaneous land type occurs in hilly areas (6 to 18 percent slopes) throughout the county but mainly in the northwestern part. Except that its parent material is more variable, Hilly gravelly land is similar to the Sioux and Zahl soils. It has formed from glacial deposits made up of poorly sorted sand, gravel, loam, and clay loam. Any of these different materials may be in the profile in various sequences. Also, in many places soil material formed from gravel is only a few feet away from that formed from clay loam.

Figure 10.--Area of Harriet-Lane silty clay loams, nearly level, that has an uneven cover of vegetation. Short grasses normally are more prevalent on the Harriet soil than on the Lane.

Most areas of Hilly gravelly land are used for pasture. Grazing should be controlled so that erosion can be kept to a minimum. Many areas have been overgrazed, and, as a result, short grasses and weeds have replaced the more productive grasses. In these places, yields of forage could be increased by reducing the stocking rate. (Capability unit VIe-6; Shallow range site)

Houdek Series

The Houdek series consists of deep, dark-colored, friable, nearly level to hilly soils. These soils are in the northwestern quarter and along the southeastern edge of the county. Most nearly level and undulating areas are cultivated, but rougher areas are grazed or used for hay.

These are well-drained soils that have formed in loam glacial till. The surface layer is granular, dark-colored loam, 4 to 8 inches thick. It is thinnest on steep slopes and thickest in nearly level areas. The loam subsoil is about 16 inches thick and has prismatic structure. A layer splotched with segregations of white carbonate is in the lower part of the subsoil and the upper part of the substratum. The substratum is slightly to moderately saline loam glacial till that is slowly permeable.

In many undulating areas of Houdek soils in Plato, Linn, Carlton, and Wheaton Townships, the substratum contains pockets of sand.

Houdek loam, nearly level (HhA) (0 to 2 percent slopes).--This soil has no serious management problems. Nevertheless, stubble-mulch tillage is needed to reduce wind erosion in fallow fields.

The soil is used mainly for corn, small grain, and alfalfa. Nitrogen fertilizer and possibly phosphate may be needed for maximum yields, but they should be applied only if their need is indicated by soil tests. (Capability unit IIc-2; Silty range site)

Houdek loam, undulating (HhB) (3 to 5 percent slopes).--This soil has many short slopes, and water erosion may occur if it is not protected by

crop residues. In other respects, this soil is similar to Houdek loam, nearly level. (Capability unit IIe-2; Silty range site)

Houdek loam, rolling (HhC) (6 to 8 percent slopes).--This soil is subject to severe water erosion if it is used continuously for row crops. Small grain, hay, and pasture are more suitable. In most areas there are many low knolls. Terracing and contour farming are not practical. (Capability unit IIIe-2; Silty range site)

Houdek-Bonilla loams, nearly level (HkA) (0 to 2 percent slopes).--Houdek loam makes up approximately 50 to 70 percent of this complex; Bonilla loam, 30 to 40 percent; and Cresbard, Cavour, and Tetonka soils, 5 to 15 percent. Houdek loam is on gentle slopes and rises, and the other soils are in level areas and in drainageways.

The soils of this complex are fertile, and they are used mainly for corn, small grain, and alfalfa. Some areas may need nitrogen fertilizer and possibly phosphate for maximum yields of crops. The need for fertilizer and the amount to be applied should be determined by soil tests. (Capability unit IIc-2; Silty range site)

Houdek-Bonilla loams, undulating (HkB) (3 to 5 percent slopes).--This complex of soils is similar to Houdek-Bonilla loams, nearly level. The areas have many short slopes, however, and erosion may be severe unless stubble-mulch tillage is practiced. Terracing and contour farming may be feasible where the slope is continuous for some distance. (Capability unit IIe-2; Silty range site)

Houdek-Cavour loams, nearly level (HlA) (0 to 2 percent slopes).--Houdek loam makes up from 40 to 70 percent of this complex; Cavour loam, 20 to 40 percent; and Cresbard, Bonilla, and Miranda soils, 10 to 20 percent. The Houdek soil is on knolls or gentle slopes, and the other soils are in drainageways and level areas. The Cavour soil has a claypan that retards the penetration of plant roots. The soils of this complex are used for cultivated crops and forage plants. (Capability unit IIIs-9; Silty range site)

Houdek-Cavour loams, undulating (HlB) (3 to 5 percent slopes).--This complex of soils is similar to Houdek-Cavour loams, nearly level. Because of the undulating topography, however, it is more susceptible to erosion. Stubble-mulch tillage will help to reduce loss of soil. (Capability unit IIIe-9; Silty range site)

Houdek-Miranda complex, nearly level (HmA) (0 to 2 percent slopes).--From 50 to 80 percent of this complex is Houdek soil; 20 to 30 percent, Miranda; and 10 to 30 percent, Cavour, Cresbard, and Bonilla. The Miranda soil, which has a claypan near the surface, has unfavorable structure and, in many areas, lacks vegetation. This complex of soils is used mainly for pasture. (Capability unit IVs-91; Silty range site)

Houdek-Miranda complex, undulating (HmB) (3 to 5 percent slopes).--This complex of soils is similar to Houdek-Miranda complex, nearly level, but the Houdek soil has many short slopes, and it is susceptible to water erosion. Stubble-mulch tillage will help to control erosion in cultivated areas. (Capability unit IVs-91; Silty range site)

Houdek-Sioux complex, undulating (HsB) (3 to 5 percent slopes).--Approximately 70 percent of this complex is Houdek soil; 20 percent, Sioux; and 10 percent, Zahl, Bonilla, and Cresbard. The Sioux soil has a gravelly subsoil. In places there are gravelly and sandy soils that have prismatic structure in the subsoil and resemble the Houdek soil.

The areas of this complex are seldom cultivated. They are used mainly for pasture, but some pastures have been overused. Stocking rates should be reduced in these pastures for a few years so that the more productive grasses will replace the weeds. (Capability unit IIe-2; Silty-Shallow Complex range site)

Houdek-Sioux complex, rolling (HsC) (6 to 8 percent slopes).--Except that the Houdek soil has a thinner surface layer, this complex of soils is similar to Houdek-Sioux complex, undulating. It is used for pasture and hay. (Capability unit IVe-5; Silty-Shallow Complex range site)

Houdek-Sioux complex, hilly (HsD) (9 to 14 percent slopes).--This complex of soils is similar to Houdek-Sioux complex, undulating, except that it is more hilly and contains a larger proportion of the Zahl soil. The Zahl soil has a thin, dark-colored surface layer. It is very susceptible to erosion, especially if the protective grasses are destroyed through cultivation or overgrazing.

Most areas of this complex are used for pasture. (Capability unit VIe-5; Silty-Shallow Complex range site)

Houdek-Zahl complex, rolling (HtD) (6 to 8 percent slopes).--About 60 to 70 percent of this complex is Houdek soil; 20 to 30 percent, Zahl; and 10 to 20 percent, associated soils. The Zahl soil generally has a thin, dark-colored gravelly surface layer.

The areas of this complex are used for pasture. (Capability unit IIIe-2; Silty-Shallow Complex range site)

Houdek-Zahl loams, rolling (HuD) (6 to 8 percent slopes).--This soil complex is similar to Houdek-Zahl complex, rolling, but the Zahl soil has a loam surface layer instead of a gravelly one.

Most areas of this complex are used for pasture or hay. Overgrazed areas need to be reseeded to productive grasses. If the soils are cultivated, row crops should seldom be grown. Excessive erosion occurs if such crops are grown too often. (Capability unit IIIe-2; Silty-Shallow Complex range site)

Hoven Series

The Hoven series consists of deep, dark-colored soils that have a claypan near the surface. These soils are in depressions that are ponded part of the year. Most areas are used for pasture.

The Hoven soils are poorly drained. Local alluvium is the parent material of at least the upper part of the profile. The substratum consists of glacial till, loess, or alluvium. The soils have a grayish-colored silty clay loam or silt loam surface layer, 1 to 5 inches thick. The subsoil is a slowly permeable, dark-colored claypan of silty clay or

clay texture. This layer ranges from a few inches to several feet in thickness. Although water frequently covers the soils, the lower part of the claypan remains dry, except during seasons with much precipitation.

Hoven silty clay loam (Hv) (0 to 1 percent slopes).--This is the only Hoven soil mapped in the county. The areas are wet, and, if soil does not have an excessively permeable substratum, they are good sites for stockwatering ponds and dugouts. Before a dugout is constructed, an auger should be used for detecting permeable sandy zones in the substratum.

This soil should be used for pasture or hay. Western wheatgrass generally is the main plant. (Capability unit VIw-19; Overflow Dense Clay range site)

Hurley Series

The Hurley series consists of deep, dark-colored, nearly level soils that have a claypan near the surface. These soils are on low benches along streams in the southwestern part of the county. Most of the areas are used for pasture.

The Hurley are somewhat poorly drained soils that formed in silty clay or clay alluvium. This material probably washed from adjacent sloping soils that developed from shale. The gray silt loam or silty clay loam surface layer is about an inch thick. It overlies a compact claypan that has columnar structure. The lower part of the claypan and the substratum normally are moderately to highly saline.

Hurley-Orman silty clays, nearly level (HyA) (0 to 2 percent slopes).--About 60 percent of this complex is Hurley soil, and 40 percent is Orman. The soils are not very fertile, and they have unfavorable structure. Some areas are flooded periodically by streams or by runoff from adjacent slopes. These areas dry slowly, and they should not be used for pasture when wet. If the soils are trampled when wet, the surface layer will be compacted and some of the vegetation will be destroyed. (Capability unit VIs-91; Panspots range site)

LaDelle Series

The LaDelle series consists of deep, dark-colored, friable, nearly level soils formed from water-deposited material. These soils are in all parts of the county. They are on nearly level benches along streams (fig. 11) and on foot slopes. Most large areas are cultivated. Meandering streams isolate some small areas and make cultivation impractical.

The LaDelle are well drained to moderately well drained soils that consist of alluvium. The profile is made up of loam, silt loam, or silty clay loam. The dark-colored, granular surface layer is 6 to 10 inches thick, and it is noncalcareous. In most places, the subsoil has prismatic structure. The lower part of the profile is slightly to moderately saline.

In some areas the subsoil and substratum consist of thin, dark-colored layers that were formerly surface layers. These layers are separated by light-colored layers. In some areas along drainageways, the subsoil and substratum have pockets of sand and gravel.

Figure 11.--LaDelle silt loam on a low bench, or stream terrace, along Lake Louise.

LaDelle loam, nearly level (LaA) (0 to 2 percent slopes).--This soil is on long, gentle foot slopes next to the Ree Hills and the Wessington Hills. The profile normally consists of loam, but, in some places, it has sandy layers.

Areas of this soil are small and are generally managed like the adjacent soils. Corn, small grain, and alfalfa are grown. (Capability unit IIc-2; Silty range site)

LaDelle silt loam, nearly level (LbA) (0 to 2 percent slopes).--This soil is on nearly level benches along streams in the northern half and in the south-central part of the county. A few areas are flooded occasionally (fig. 12).

This soil has no serious management problems. Nevertheless, it may be eroded by wind unless crop residues are kept on the surface.

Most areas are used to grow corn, small grain, and alfalfa. Areas in the more humid eastern part of the county are more productive than other areas. (Capability unit IIc-2; Silty range site)

Figure 12.--LaDelle soil on bottom lands that are flooded occasionally.

LaDelle silty clay loam, nearly level (LcA) (0 to 2 percent slopes).--This soil is similar to LaDelle silt loam, nearly level, except that it is made up of silty clay loam. It is in the southern part of the county. Small grain and alfalfa are grown. (Capability unit IIs-1; Clayey range site)

LaDelle silty clay loam, fans, nearly level (LdA) (0 to 2 percent slopes).--This soil is in nearly level areas adjacent to the Ree Hills, the Wessington Hills, and the Orient Hills. The profile is made up of silty clay loam.

This soil has no serious management problems. In some areas, however, grassed waterways may be needed to collect runoff from adjacent slopes and thereby prevent erosion. Stubble-mulch tillage will help to control wind erosion in fallow fields.

Most areas of this soil are used for crops--mainly corn, small grain, and alfalfa. (Capability unit IIs-1; Clayey range site)

LaDelle-Aberdeen silty clay loams, nearly level (LeA) (0 to 2 percent slopes).--The surface layer of this complex is generally of silty clay loam. About 80 percent of the complex is LaDelle soil, and 20 percent, Aberdeen soil.

The Aberdeen silty clay loam in this complex has formed from stream-deposited sediment. It is similar to Cavour soils that have a moderately compact claypan.

This complex of soils is used for cultivated crops and pasture. (Capability unit IIIs-9; Clayey range site)

LaDelle-Lamoure silt loams, nearly level (LlA) (0 to 2 percent slopes).--This complex of soils is in the northern half and south-central part of the county. About 60 percent of it is LaDelle silt loam, and 40 percent is Lamoure silt loam. The soils are on low benches along streams and in bottom lands, and they are flooded occasionally.

Large areas of these soils are used for crops. Many areas have been separated into small segments by meandering streams. These spots are used for pasture. Normally, flooding does not damage pasture plants. (Capability unit IIw-1; Silty range site)

Lamoure Series

The Lamoure series consists of deep, dark-colored, nearly level soils. These soils are on stream bottoms in the northern and south-central parts of the county. Most areas are used for hay or for grazing.

The Lamoure are poorly drained soils that have formed in material deposited by streams. In general, their profile is made up of silty clay loam, loam, or silt loam, but, in places, the substratum has pockets of sand and gravel. The soils are calcareous throughout and are generally saline in the lower part of the profile. The dark-colored, granular surface layer is 8 to 10 inches thick.

In many places where Lamoure soils are associated with the LaDelle silt loams, they have a loam or silt loam profile.

Lamoure silty clay loam, nearly level (LmA) (0 to 2 percent slopes).--This soil is moderately fertile and has fair tilth. Flooding and wetness limit yields of crops, however. The length of time the areas are wet can be reduced if runoff is controlled by the use of drainage ditches and by terracing adjacent slopes in the uplands. (Capability unit IVw-11; Subirrigated range site)

Lane Series

The Lane series consists of deep, dark-colored nearly level to gently sloping soils. These soils are mainly in the southern and western parts of the county. Some are suitable for cultivation, but others should be used for hay or pasture.

The Lane are well-drained to poorly drained soils that have formed from loam, silty clay loam, silty clay, or clay alluvium. The surface layer generally is dark colored, has granular structure, and is 4 to 10 inches thick. The subsoil, which is about 20 to 30 inches thick, has prismatic and blocky structure. In many places the substratum is saline.

Lane loam, gently sloping (LnB) (3 to 5 percent slopes).--This well drained to moderately well drained soil is on gentle foot slopes of the Ree Hills and the Wessington Hills (fig. 13). The loam parent material was deposited by streams from these hills. The depth to the substratum of glacial till varies.

Many areas of this mapping unit contain some Houdek soil, which has formed where the till is at the surface.

Lane loam, gently sloping, is subject to wind erosion during dry seasons if it is not protected by growing crops or their residues. Grassed waterways are needed in some small drainageways.

Most areas of this soil are used to grow small grain, alfalfa, and corn. (Capability unit IIe-2; Silty range site)

Lane silty clay, nearly level (LoA) (0 to 2 percent slopes).--This moderately well drained to somewhat poorly drained soil has formed in silty clay material deposited by floodwaters of small streams (fig. 14). Most areas are rarely flooded, but they dry slowly after rainy periods. In Hulbert Township parts of some areas have a gravelly substratum and parts of others have a very calcareous

Figure 13.--Lane loam on the long gentle slope in the foreground. This soil has formed from material deposited by streams that flow from the Ree Hills in the background.

Figure 14.--Nearly level area of Lane silty clay that is protected by an excellent shelterbelt.

surface layer. In most places, however, the surface layer is noncalcareous.

Most areas of this soil are cultivated successfully, but, in places, surface drainage would improve production. The silty clay or clay surface layer is loose and granular during winter and spring, and, unless stabilized by crop residues, it is very susceptible to wind erosion. It will puddle if cultivated when too wet. (Capability unit IIs-1; Clayey range site)

Lane-Exline silty clay loams, nearly level (LpA) (0 to 2 percent slopes).--These moderately well drained to somewhat poorly drained soils consist of alluvial material. This material was deposited along streams and also where water from small drainageways flowed from adjacent hilly areas into nearly level areas. The Lane soil makes up about 70 percent of this complex, and the Exline soil, 30 percent. Lane silty clay loam generally is slightly thicker and darker than LaDelle silty clay loam, fans, nearly level, but in other respects the two soils are similar. Exline silty clay loam has a claypan near the surface.

The soils of this complex are used for crops, mainly winter wheat and alfalfa. Wind erosion may be severe in plowed fields during winter and the early part of spring. (Capability unit IIIs-9; Clayey range site)

Lane-Exline silty clays, level (LrA) (0 to 1 percent slopes).--This complex consists mainly of Lane silty clay. The Exline soil in this complex has a claypan, and it is not so productive as Lane silty clay.

Most areas are cultivated or used for hay. Winter wheat and alfalfa are the main crops. Wind erosion is a problem, but it can be reduced through stubble-mulch tillage. (Capability unit IIIs-9; Clayey range site)

Lane-Harriet silty clay loams, nearly level (LsA) (0 to 2 percent slopes).--This complex of soils is along streams in the southern part of the county. It is similar to Harriet-Lane silty clay loams, nearly level, except that it contains a greater percentage of the Lane soil than the Harriet.

In most areas of this complex, the soil is weakly developed and contains dark-colored buried layers. These areas are flooded occasionally by streams or by runoff from the adjacent uplands. In some areas the soils have a calcareous surface layer and periodically have a high water table.

The soils of this complex are used mainly for pasture. Grazing should be controlled so that productive grasses are not destroyed. (Capability unit IVs-91; Clayey range site)

Lismas Series

The Lismas series consists of shallow soils that have a thin surface layer. These soils are underlain by shale. They are in steep areas in the southwestern part of the county and are used for pasture.

These are excessively drained soils that have formed in material weathered from Pierre shale. In places the upper layers of the profile contain some sand and gravel that were mixed with shale fragments by glaciers. The dark-colored silty clay surface layer generally is less than 3 inches thick and has granular structure. In most places there is a subsoil that is 10 to 25 inches thick, has prismatic structure, and has formed in partly disintegrated fragments of shale. In very steep areas, however, the surface layer overlies a layer of shale fragments that was derived from the substratum of compact shale.

The Lismas soils are slightly to strongly calcareous, and their subsoil may contain salts.

Lismas-Promise silty clays, hilly (LtD) (9 to 14 percent slopes).--Lismas soil makes up 40 to 60 percent of this complex; Promise, 30 to 40 percent; and Gann, Raber, and Zahl, less than 30 percent. The soils of this complex are not very fertile, and they are used for pasture. Grazing should be carefully controlled so that a protective cover of vegetation is maintained. Otherwise, the thin surface layer will erode and very little forage will be produced. (Capability unit VIe-1; Shallow range site)

Maddock Series

The Maddock series consists of deep, nearly level to undulating sandy soils. These soils are in the central and northeastern parts of the county. They are used for pasture and crops.

These are well-drained soils that have formed from sandy material. Most of the sand was deposited by glacial melt water, and later it was moved about by the wind. As a result, in most areas, the soils contain some gravel and small stones. The dark sandy loam surface layer is generally about 8 to 10 inches thick. Below this layer is loose loamy sand that is similar to the parent material.

Maddock sandy loam (Ma).--This soil is nearly level to gently sloping (2 to 4 percent slopes). It is of low fertility but has good tilth. The sandy soil material is very permeable, so water erosion normally is not a serious problem. Soil drifting, however, is a problem in cultivated areas that

lack a cover of vegetation. This soil is used for corn, small grain, and alfalfa, as well as for pasture. (Capability unit IVe-4; Sandy range site)

McKenzie Series

The McKenzie series consists of deep, dark-colored, level clayey soils. These soils are in the western part of the county. Most of the areas are used for pasture or hay.

These are poorly drained soils that have formed from silty clay and clay deposited in basins by streams during and following the last glacial period. Later, streams cut channels into the clay-filled basins and partly drained them.

The topography of these soils is uneven. It consists of small depressions, a few feet wide, interspersed with microknolls, 4 to 8 inches high (fig. 15). The soils in the depressions have a thin, gray surface layer, about an inch thick, underlain by a dark-colored claypan with columnar structure. The soils on the low rises have a thin, dark-colored clay surface layer, 2 to 3 inches thick, and a lighter colored clay subsoil.

The McKenzie soils are calcareous. Those on the microknolls contain salts at the surface, and those in depressions contain salts at a depth of 10 to 15 inches.

The soils dry slowly, have poor tilth, and are not very fertile. Because of these unfavorable characteristics, most areas of these soils probably should not be cultivated. Western wheatgrass is the dominant vegetation, but blue grama and saltgrass are common on the microknolls.

McKenzie clay, level (McA) (0 to 1 percent slopes).--This is the only McKenzie soil mapped in the county. It is used mainly for pasture or hay. Grazing should be controlled so that the productive grasses are not replaced by weeds. (Capability unit VIs-1; Overflow range site)

Miranda Series

The Miranda series consists of deep, dark-colored, nearly level to gently sloping soils that have a claypan near the surface. These soils are in most parts of the county. They are used mainly as pasture.

Figure 15.--McKenzie clay on uneven topography with small basins and low rises.

The Miranda are moderately well drained to somewhat poorly drained soils in small drainageways in the uplands. They have developed from loess, glacial till, alluvium, or a combination of these materials. In most places there is a gray silt loam surface layer, generally less than an inch thick. The claypan consists of silty clay loam or silty clay with columnar structure. Salts and alkali are in the lower part of the claypan and in the slowly permeable substratum.

The areas of these soils have sparse vegetation. They are interspersed with barren spots, where the claypan is at the surface.

Miranda complex, nearly level (MdA) (0 to 2 percent slopes).--Miranda soil makes up approximately 75 percent of this complex, and Cavour and Cresbard, 25 percent.

The Miranda soil is not very fertile, and it has poor tilth. If it is cultivated, the soil should be dry enough that it will not be further compacted. In pastured areas, grazing should be limited so that some vegetation will be maintained to protect small, nearly barren spots from wind erosion. Any further erosion will lower yields of forage. (Capability unit VIs-91; Panspots range site)

Miranda-Eakin complex, nearly level (MeA) (0 to 2 percent slopes).--This complex of soils is in the southern part of the county. Approximately 60 percent of it is Miranda soil; 30 percent, Eakin; and 10 percent, Cavour, Cresbard, and Raber. The areas of this complex are used mainly for pasture, because the Miranda soil has a dense claypan near the surface that retards roots of cultivated crops. (Capability unit VIs-91; Panspots range site)

Miranda-Houdek complex, nearly level (MhA) (0 to 2 percent slopes).--This complex of soils is in the northeastern and central parts of the county. About 50 percent of it is Miranda soil; 30 percent, Houdek; and 20 percent, Cavour, Cresbard, and Bonilla. Houdek loam is on low knolls and gentle slopes.

Some areas of this complex could be improved by drainage ditches. Most of the areas are used for pasture. (Capability unit VIs-91; Panspots range site)

Miranda-Houdek complex, undulating (MhB) (3 to 5 percent slopes).--This complex of soils is similar to Miranda-Houdek complex, nearly level, except that it has many gentle slopes and is more susceptible to erosion. Most of the areas are used for pasture. (Capability unit VIs-91; Panspots range site)

Miranda-Raber complex, nearly level (MrA) (0 to 2 percent slopes).--Miranda soil makes up 50 percent of this complex; Raber, 30 percent; and Cavour, Cresbard, and Eakin, 20 percent. Much of the surface is rough, pitted, and, in small spots, nearly barren. Most of the areas are used for pasture or hay. (Capability unit VIs-91; Panspots range site)

Miranda-Raber complex, undulating (MrB) (3 to 5 percent slopes).--Except in slope, this complex of soils is similar to Miranda-Raber complex, nearly level. When the areas are cultivated, the

Raber soil on short, gentle slopes is slightly susceptible to erosion. (Capability unit VIs-91; Panspots range site)

Miranda-Williams complex, nearly level (MwA) (0 to 2 percent slopes).--This complex of soils is in the south-central part and in the northwestern quarter of the county. Approximately 50 percent of it is Miranda soil; 30 percent, Williams; and 20 percent, Cavour, Cresbard, and Bonilla. Most of the areas are used for pasture. (Capability unit VIs-91; Panspots range site)

Mondamin Series

The Mondamin series consists of deep, dark-colored soils. These soils are in the southern part of the county. They are mainly on nearly level and gently sloping tops of hills that have steep side slopes (fig. 16). The larger areas of these soils are cultivated. Small areas adjacent to steep slopes are grazed.

These well drained and moderately well drained soils have formed from stratified silty clay loam deposited by glacial melt water. The silty clay loam or silt loam surface layer is dark colored, granular, and 3 to 6 inches thick. The subsoil of silty clay loam has prismatic structure and is 20 to 30 inches thick. In its lower part, there are white masses of carbonates. The substratum contains layers that resemble shale.

Mondamin silty clay loam, gently sloping (MyB) (3 to 5 percent slopes).--This is the only soil of the Mondamin series in the county. The surface layer is silty clay loam in most places. It is, however, silty clay or clay in areas in sec. 23, T. 109 N., R. 66 W. In these areas the soil has a less desirable structure and is probably slightly less productive than typical.

This soil, particularly where it has a silty clay surface layer, is susceptible to wind erosion unless it is protected by vegetation. If the soil is cultivated when it is too wet, the surface layer will be compacted into a hard mass that has unfavorable structure. A cropping system that returns a large amount of organic matter to the soil will help to maintain or improve the structure. (Capability unit IIIe-1; Clayey range site)

Figure 16.--Mondamin soils on gently sloping tops of knolls.

Oahe Series

The Oahe series consists of dark-colored, friable, nearly level soils that are underlain by sand and gravel. These soils are in the western and southern parts of the county. Most areas are cultivated.

These well drained to moderately well drained soils have formed in loam that is at least 20 inches thick. The dark-colored, friable loam surface layer is 3 to 6 inches thick. The loam or clay loam subsoil has prismatic structure, and the lower part normally is splotched with white masses of carbonates. The substratum is made up of sand and gravel that is permeable and generally nonsaline.

Oahe loam, nearly level (OaA) (0 to 2 percent slopes).--This soil is moderately fertile and has good tilth. Water erosion may occur on the more sloping areas, but wind erosion is a more serious problem. A protective cover of crops or their residues will help to control both kinds of erosion.

Most areas of this soil are used for crops. (Capability unit IIIs-5; Silty range site)

Oahe loam, undulating (OaB) (3 to 5 percent slopes).--This soil is similar to Oahe loam, nearly level. However, in addition to steeper slopes, it has a slightly thinner, dark-colored surface layer that is more susceptible to water erosion.

Soils with a claypan are included in some of the mapped areas of this soil. These areas are in sec. 3, T. 113 N., R. 69 W.; sec. 7, T. 115 N., R. 70 W.; sec. 13, T. 109 N., R. 69 W.; and secs. 4, 8, 9, and 18, T. 109 N., R. 68 W.

Oahe loam, undulating, is used for cultivated crops, hay, and pasture. The areas that include claypan soils have a saline substratum and occasionally have a high water table; they are used for pasture. (Capability unit IIIe-5; Silty range site)

Oahe-Sioux loams, nearly level (OhA) (0 to 2 percent slopes).--Oahe soil makes up 70 percent of this complex, and Sioux, 30 percent. The Oahe soil has gravel in the substratum. The Sioux soil has gravel in the subsoil and tends to be droughty.

This complex of soils is used for pasture and crops. Cultivated areas can best be used for small grain or hay crops. These crops mature before the summer droughts and do not have to depend on moisture from the lower part of the subsoil. Wind erosion is a problem, but it can be reduced by stubble-mulch tillage. (Capability unit IVs-6; Silty-Shallow Complex range site)

Oahe-Sioux loams, undulating (OhB) (3 to 5 percent slopes).--This complex of soils is similar to Oahe-Sioux loams, nearly level, but it has steeper slopes and generally contains a greater proportion of Sioux loam. Water erosion may be severe on the more sloping parts of cultivated areas, but it can be limited by stubble-mulch tillage. (Capability unit IVs-6; Silty-Shallow Complex range site)

Orman Series

The Orman series consists of deep, dark-colored, fine-textured soils. These soils are in the southwestern part of the county. Large areas are cultivated.

These well drained to moderately well drained soils consist of silty clay or clay alluvium washed from the Promise or Lismas soils. In uneroded areas, the silty clay surface layer is dark colored, granular, and 2 to 4 inches thick. The silty clay subsoil has prismatic and blocky structure. The substratum is made up of alluvium, shale, or clay glacial till. It is slowly permeable and generally slightly salty and alkaline.

In some areas there are buried soils in the subsoil and substratum.

Orman silty clay, nearly level (OrA) (0 to 2 percent slopes).--Most of this soil is on gentle slopes between the channel of Elm Creek and the adjacent uplands. It is fairly fertile. The soil normally lacks good tilth, however, because it puddles if tilled when there is a slight excess of moisture.

The return of crop residues to the soil will help to maintain the content of organic matter and to improve soil structure. Wind erosion may be severe unless the soil is protected by a plant cover. Unless controlled, water from soils on adjacent higher slopes may cause flooding or erosion. Grassed waterways are needed in some small drainageways on the Orman soil.

Small grain and grain sorghum are apparently more suitable for this soil than corn. (Capability unit IIs-1; Clayey range site)

Orman silty clay, gently sloping (OrB) (3 to 5 percent slopes).--This soil is more susceptible to sheet and gully erosion than Orman silty clay, nearly level. Grassed waterways will reduce gully erosion. Some areas of this soil are large enough to be farmed on the contour. (Capability unit IIIe-1; Clayey range site)

Promise Series

The Promise series consists of deep, dark-colored, fine-textured soils. These gently sloping to steep soils are in the southwestern part of the county. Most areas are used for pasture, but large gently sloping areas can be cultivated.

The Promise soils are well drained. Their parent rock is Pierre shale that was overridden by glaciers. The upper part of the profile has developed in a mixture of clay derived from the shale and coarse material carried in by the glaciers. The surface layer of clay or silty clay is dark colored, has granular or blocky structure, and is 2 to 5 inches thick. The clay subsoil has prismatic structure, and the lower part may contain segregations of salts and carbonates. The substratum of Pierre shale is at a depth of about 30 inches.

Promise silty clay, gently sloping (PrB) (3 to 5 percent slopes).--This soil occurs along the valley of Elm Creek.

Erosion is the main problem. In cultivated areas wind erosion may be severe if the surface is not protected by growing vegetation or crop residues. Because this clayey soil is not very permeable, water tends to run off and cause erosion. Contour cultivation and stripcropping will help to control erosion. In some areas grassed waterways will help to stabilize small gullies. If the soil is cultivated when it contains too much water, the surface will puddle.

In overused pastures erosion may also be a problem. (Capability unit IIIe-1; Clayey range site)

Promise silty clay, sloping (PrC) (6 to 8 percent slopes).--Except in slope, this soil is similar to Promise silty clay, gently sloping. Most of the areas are used for pasture. (Capability unit IVe-1; Clayey range site)

Promise silty clay, moderately steep (PrD) (9 to 14 percent slopes).--Because of the moderately steep slopes, this soil should not be cultivated. The areas are used mainly for pasture. If grazing is not controlled, the protective cover of grass will be destroyed and erosion will be severe. (Capability unit VIe-1; Clayey range site)

Raber Series

The Raber series consists of deep, dark-colored, nearly level to hilly soils. These soils are in the southern part of the county. Most of the large, nearly level to gently sloping areas are cultivated, but the steeper areas are grazed.

These are well-drained soils that have formed from clay loam glacial till that, in places, is mantled with 2 or 3 inches of loess. The dark-colored loam surface layer has granular structure and is 2 to 4 inches thick. The clay loam subsoil has prismatic structure and is about 30 inches thick. Its lower part contains white, moderately hard masses of carbonates and some alkali. The upper part of the profile is moderately permeable, but the substratum of slightly to moderately alkaline glacial till is slowly permeable.

Raber loam, nearly level (RaA) (0 to 2 percent slopes).--Some of the mapped areas of this soil include a moderately well drained soil that is slightly thicker and darker than typical. Larger areas include a few small tracts of a soil that has formed from loam glacial till and is similar to the Raber soil.

Raber loam, nearly level, has no serious management problems. Nevertheless, wind erosion may occur in fallow fields. Stubble-mulch tillage will help to control erosion. The return of all crop residues to the soil will help to improve the structure of the plow layer.

Most of this soil is cultivated. (Capability unit IIc-2; Silty range site)

Raber loam, undulating (RaB) (3 to 5 percent slopes).--This soil is similar to Raber loam, nearly level, except in slope. Raber loam, undulating, is used for cultivated crops, hay, and pasture. Water erosion is a hazard on the many short, gentle slopes, but stubble-mulch tillage will help to prevent the loss of soil. Most of this soil is on low knolls, and, in general, terracing and contour farming are not feasible. Grassed waterways are needed in a few areas to prevent gullies.

Areas that have eroded or have been farmed for a long time may need nitrogen fertilizer and possibly phosphate. The amounts used should be determined by soil tests.

In pastured areas, grazing should be controlled so that the more productive grasses are not replaced by short grasses and weeds. Some areas need to be reseeded to more productive plants. (Capability unit IIe-2; Silty range site)

Raber loam, rolling (RaC) (6 to 8 percent slopes).--This rolling or sloping soil is thinner and more susceptible to erosion than the less sloping Raber loams. If the soil is cultivated, stubble-mulch tillage will be needed to help control erosion. Where the slope is continuous, terracing and contour farming may be practical.

Most areas of this soil are used for pasture or hay. (Capability unit IIIe-2; Silty range site)

Raber-Cavour loams, nearly level (RcA) (0 to 2 percent slopes).--About 70 percent of this complex is Raber soil; 20 percent, Cavour; and 10 percent, Miranda, Cresbard, and Eakin. Raber loam is on gently sloping sites and Cavour loam is on level sites and in drainageways. The Cavour soil has a claypan in the subsoil.

The areas of this complex are used for pasture and crops. (Capability unit IIIs-9; Silty range site)

Raber-Cavour loams, undulating (RcB) (3 to 5 percent slopes).--Except for slope, this complex of soils is similar to Raber-Cavour loams, nearly level. The Raber soil has many short slopes, and water erosion is moderate in cultivated fields. Stubble-mulch tillage will help to prevent loss of soil. Areas of the Cavour soil in drainageways dry slowly and may puddle if tilled when wet. (Capability unit IIIe-9; Silty range site)

Raber-Eakin complex, nearly level (ReA) (0 to 2 percent slopes).--This complex of soils is in the southern part of the county. About 60 percent of it is Raber soil; 30 percent, Eakin; and 10 percent, Cavour and Cresbard. Wind erosion may occur in fallow fields, but it can be reduced by stubble-mulch tillage.

Most of this complex of soils is used for crops. Corn, small grain, and alfalfa are grown. (Capability unit IIc-2; Silty range site)

Raber-Eakin complex, undulating (ReB) (3 to 5 percent slopes).--This complex of soils is similar to Raber-Eakin complex, nearly level, except that it has many short, gentle slopes that are subject to severe water erosion. Both water and wind erosion on fallow fields can be reduced by stubble-mulch tillage. Nitrogen fertilizer and possibly phosphate may be needed in some fields. In pastured areas, grazing should be controlled so that productive grasses are not replaced by weeds.

Small grain, alfalfa, and corn are grown in cultivated areas. Many areas are used for pasture or hay. (Capability unit IIe-2; Silty range site)

Raber-Eakin complex, rolling (ReC) (6 to 8 percent slopes).--The soils of this complex have many short slopes. On these slopes the soils are not so thick as those of Raber-Eakin complex, undulating.

Most areas of this complex are used for pasture or hay. Grazing should be controlled so that productive grasses are not replaced by weeds. If the soil is cultivated, small grain and hay, which give more protection against erosion, should be grown instead of intertilled crops. (Capability unit IIIe-2; Silty range site)

Raber-Miranda complex, nearly level (RmA) (0 to 2 percent slopes).--Raber soil makes up about 70 percent of this complex; Miranda, 20 percent; and Cavour, Cresbard, and Eakin, 10 percent. The Raber soil is in the better drained places, and the other soils are in drainageways and level areas. The Miranda soil has a claypan near the surface that restricts growth of roots and, consequently, causes low yields of crops.

The areas of this complex are used mainly for pasture and hay. (Capability unit IVs-91; Silty range site)

Raber-Miranda complex, undulating (RmB) (3 to 5 percent slopes).--Except that the Raber soil is more sloping, this complex of soils is similar to Raber-Miranda complex, nearly level. The more sloping parts of cultivated areas are susceptible to water erosion. Stubble-mulch tillage, however, will help to prevent both water and wind erosion.

Small grain and alfalfa are the main crops grown on areas of this complex. Areas that have many short slopes are normally used for pasture or hay. (Capability unit IVs-91; Silty range site)

Raber-Zahl complex, rolling (RpC) (6 to 8 percent slopes).--About 60 percent of this complex is Raber soil; 25 percent, Zahl; and 15 percent, Gann, Eakin, and a gravelly soil similar to the Sioux. In most places the Zahl soil has a thin, dark-colored gravelly surface layer.

Most areas of this complex are used for pasture. (Capability unit IIIe-2; Silty-Shallow Complex range site)

Raber-Zahl loams, rolling (RrC) (6 to 8 percent slopes).--About 60 percent of this complex is Raber loam; 30 percent, Zahl loam; and 10 percent, Gann and Eakin soils. The Zahl soil is on the steeper areas, and it has a very thin surface layer of loam texture.

Most of the areas of this complex are used for pasture. Grazing should be controlled so that productive grasses are not replaced by weeds. Some pastures need to be reseeded. (Capability unit IIIe-2; Silty-Shallow Complex range site)

Rolling Sandy Land

Rolling sandy land (Rs).--This miscellaneous land type consists of sandy and gravelly material. The topography is mainly rolling to steep (6 to 14 percent slopes). On slopes the soil material is thin and low in organic matter, but in slight swales it is thick and high in organic matter.

Most of the areas are used for grazing. Large amounts of forage were produced by the native grasses. Most of the areas have been overgrazed, however, and the productive grasses have been replaced by short grasses and weeds. A reduced stocking rate will help to reestablish the more desirable grasses and to increase the production of forage. Some areas may need to be seeded. (Capability unit IVe-3; Shallow range site)

Rough Broken Land

Rough broken land (Ru).--This miscellaneous land type has steep slopes (10 to 25 percent slopes). It occurs in the southwestern corner of the county. The component soils vary in different areas of this land type. Most areas contain Lismas, Sioux, Zahl, Promise, and Raber soils. The higher areas have soils formed in gravel or in glacial till, and the lower areas have soils formed in glacial till or material weathered from Pierre shale.

Rough broken land is used for grazing. Control of grazing is needed so that the taller productive grasses are encouraged and steep slopes are protected against erosion. (Capability unit VIe-6; Shallow range site)

Saline Alluvial Land

Saline alluvial land (Sa).--This miscellaneous land type is in wet, nearly level (0 to 2 percent slopes) areas along streams and at the edges of depressions. The soil material is of loam or clay loam texture throughout the profile. It is salty and generally calcareous. The very saline areas have a thin, dark-colored surface layer, but the slightly saline areas have a dark-colored surface layer that is 8 to 10 inches thick.

Most areas of Saline alluvial land are used for hay or pasture. Grazing should be controlled so that the more productive plants are not replaced by saltgrass or weeds. (Capability unit VIw-9; Saline Lowland range site)

Sioux Series

The Sioux series consists of dark-colored, friable, shallow soils with a gravelly subsoil. These predominantly nearly level to gently sloping soils are in all parts of the county. Most large areas are on nearly level benches along streams. The topography is hilly, however, in places where the Sioux soils occur in complexes with the Raber, Williams, and Houdek soils. The large, nearly level areas of Sioux soils are cultivated, and the more sloping areas are used for pasture or hay.

The Sioux soils are well drained and have formed from material deposited by glacial melt water. The dark-colored, friable loam surface layer has granular structure and is 3 to 6 inches thick. The loam or clay loam subsoil has prismatic structure. It is underlain by a gravelly and sandy substratum that generally begins at a depth of 12 to 20 inches.

Sioux loam (Sm).--This nearly level to undulating soil (1 to 5 percent slopes) occurs throughout the county.

The gently sloping areas need management that will conserve water and control erosion. Because gravel occurs within 20 inches of the surface, these areas tend to be droughty and should be used for pasture. Grazing must be controlled carefully during dry seasons so that the more productive grasses are not replaced by short grasses and weeds. In most areas, however, overgrazing has already caused a shift toward short grasses. A reduced stocking rate would encourage the taller, more productive grasses.

Nearly level areas of Sioux loam are used for crops and pasture. In cultivated areas, stubble-mulch tillage will help to control wind erosion. The soil is moderately low in organic matter and nitrogen. If a legume is included in the cropping system, the supply can be maintained.

Areas of this soil in the more humid eastern part of the county are more productive than those in other parts. Small grain and other crops that mature before the summer droughts produce larger yields than crops that grow during the drought and must depend on moisture from the subsoil. (Capability unit IVs-6; Shallow range site)

Sioux-Oahe loams (So).--The soils of this complex are nearly level to undulating (2 to 4 percent slopes). They occur in the western and southern parts of the county. About 60 to 70 percent of this complex is Sioux soil, and 30 to 40 percent is Oahe. The Oahe soil has a gravelly substratum that begins at a depth below 20 inches.

If gently sloping areas of these soils are cultivated, they will need erosion control and moisture conservation. Because their substratum has a low water-holding capacity, these soils should be used for crops that mature before summer droughts. (Capability unit IVs-6; Shallow-Silty Complex range site)

Sioux-Wessington loams (Sw).--This complex of nearly level to undulating soils (2 to 4 percent slopes) is in the eastern part of the county. About 60 to 70 percent of it is Sioux soil, and 30 to 40 percent, Wessington. This complex is similar to Sioux-Oahe loams, but because it occurs in the eastern part of the county where rainfall is greater, the surface layer is darker and thicker. In addition, crop yields are slightly greater on soils of this complex than on Sioux-Oahe loams. (Capability unit IVs-6; Shallow-Silty Complex range site)

Spottswood Series

The Spottswood series consists of deep, dark-colored, friable soils that are underlain by sand and gravel. These nearly level soils are in the northeastern part of the county. They are used for pasture and crops.

The Spottswood soils are moderately well drained to somewhat poorly drained, and some areas occasionally have a temporarily high water table. The parent material was deposited by glacial melt water, mainly in small stream valleys. The surface layer of these soils is dark-colored, granular silt loam or loam, 8 to 12 inches thick. The subsoil is loam or silt loam, has prismatic structure, and is about 20 inches thick. The substratum is loam in the upper part, but it grades to sand and gravel at a depth of about 36 inches. Salts and alkali may occur in the upper layers or in the substratum.

Spottswood loam, nearly level (SyA) (0 to 2 percent slopes).--This soil is fertile and has good tilth. Wind erosion may occur during dry seasons, however, if the surface is not protected by vegetation or crop residues. The soil has a high water table and contains soluble salts that are brought

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to the surface by water. These limitations have reduced the yields of crops in some areas. (Capability unit IIIs-5; Silty range site)

Spottswood complex, nearly level (SxA) (0 to 2 percent slopes).--This complex is made up of the somewhat poorly drained Spottswood loam and of soils with a claypan. The depth to the claypan varies. Vegetation is sparse where the claypan is at the surface, and the soils are saline at a slight depth.

Most areas of this complex are used for pasture or hay. (Capability unit IIIs-9; Silty range site)

Tetonka Series

The Tetonka series consists of deep, dark-colored soils that have a claypan in the subsoil. These soils occur in depressions in all parts of the county. They are used for pasture, hay, or crops, depending on how well the depressions can be drained by surface ditches.

These somewhat poorly drained soils have formed mainly in material washed from the surrounding slopes. Their dark-colored, friable silt loam or loam surface layer has granular or platy structure and is 4 to 8 inches thick. The subsoil is grayish, friable silt loam that overlies a dark, compact silty clay loam or clay loam claypan with prismatic structure. The substratum is made up of alluvial material or glacial till. The upper part of the profile is free of salts and alkali. The lower part and the substratum, however, generally are slightly to moderately saline.

Tetonka silt loam, poorly drained (Tp).--Unless the depressions have been artificially drained, this soil is normally too wet for crops. In many areas the high cost of surface ditches makes drainage impractical. Some areas are wet enough for the nesting of waterfowl. The large areas of this soil can be managed as separate pastures on which grazing is controlled. Many smaller pastured areas are managed in the same way as adjacent larger areas of other soils. These areas have been overgrazed and the productive plants have been replaced by weeds. (Capability unit Vw-1; Overflow range site)

Tetonka silt loam, somewhat poorly drained (Tw).--Most of this soil is in shallow depressions that have drainage outlets. The soil is normally wet during part of each growing season. Crops usually can be planted, but in some years the planting date may have to be delayed until the soil dries. Drainage outlets can be deepened to remove excess surface water. (Capability unit IVw-9; Overflow range site)

Wessington Series

The Wessington series consists of dark-colored, friable soils that are underlain by sand and gravel. These nearly level to undulating soils are mainly on benches along streams in the central and eastern parts of the county. Most of the areas are cultivated.

These well-drained, moderately fertile soils have formed from material deposited by glacial melt water. Their dark-colored, friable loam or silt loam surface layer is 6 to 10 inches thick. The subsoil is friable loam that has prismatic structure. Sand and gravel are at a depth of about 20 to 30 inches. The upper layers of the profile and the substratum are generally nonsaline and permeable.

Wessington loam, nearly level (WeA) (0 to 2 percent slopes).--This soil has no serious management problems. Nevertheless, wind erosion occurs in dry seasons if the surface is not protected by vegetation or crop residues. Because it has a gravelly substratum, the soil tends to be droughty unless precipitation is above average. Consequently crops that mature early are more suitable than those that mature later and must depend on subsoil moisture during summer. (Capability unit IIIs-5; Silty range site)

Wessington loam, undulating (WeB) (3 to 5 percent slopes).--This soil has many short, gentle slopes. Conservation of water and erosion control are needed in cultivated fields. Stubble-mulch tillage will help to prevent loss of soil and water. (Capability unit IIIe-5; Silty range site)

Wessington-Sioux loams, nearly level (WgA) (0 to 2 percent slopes).--The Wessington soil makes up 60 to 70 percent of this complex, and the Sioux, 30 to 40 percent. Sioux loam has a gravelly subsoil, and it is more droughty than the Wessington soil. If the soils of this complex are cultivated, small grain and hay are more suitable than corn. In fallow fields, crop residues should be kept on the surface to control wind erosion. (Capability unit IVs-6; Silty-Shallow Complex range site)

Wessington-Sioux loams, undulating (WgB) (3 to 5 percent slopes).--These undulating soils are similar to the nearly level Wessington-Sioux loams, but they are more susceptible to water erosion. Stubble-mulch tillage will help to control both water and wind erosion. (Capability unit IVs-6; Silty-Shallow Complex range site)

Williams Series

The Williams series consists of deep, dark-colored, friable soils. These nearly level to sloping soils are in the south-central and northwestern parts of the county (fig. 17). The gently sloping

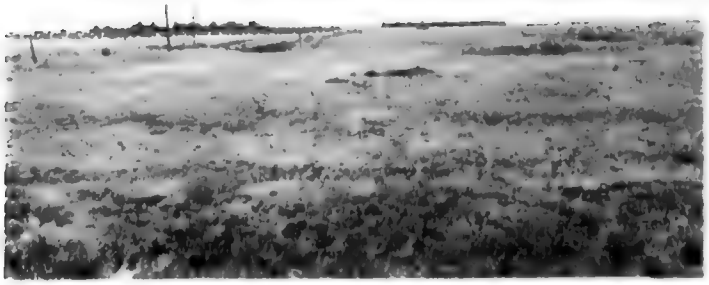

Figure 17.--Williams soils on undulating, seemingly endless prairie.

areas can be cultivated, but the steeper areas should be grazed.

These are well-drained soils that have formed mainly from loam or clay loam glacial till. In the area northwest of Ree Heights, the upper part of the profile may have developed from a till-like sediment deposited by glacial melt water.

The Williams soils have a dark-colored, friable loam or silt loam surface layer that has weak, platy or granular structure and is 3 to 6 inches thick. They have a clay loam subsoil that has prismatic structure and is about 20 inches thick. In the middle of the subsoil, there are a few soft, white segregations of carbonates. The substratum consists of glacial till of loam texture. It is slowly permeable and slightly to moderately saline.

Williams loam, undulating (WmB) (3 to 5 percent slopes).--This soil is fertile and generally has good tilth. During seasons when rainfall is normal, it is not susceptible to wind erosion but it may be eroded by runoff. In some places terracing and contour farming will help to conserve water and to reduce erosion. These measures may not be practical on short and discontinuous slopes, but stubble-mulch tillage can be used.

The areas of this soil are used for pasture, hay, and cultivated crops. (Capability unit IIe-2; Silty range site)

Williams loam, rolling (WmC) (6 to 8 percent slopes).--This rolling soil is more susceptible to erosion than the undulating Williams loam. Most of the areas are used for pasture. (Capability unit IIIe-2; Silty range site)

Williams-Bonilla loams, nearly level (WnA) (0 to 2 percent slopes).--Williams soil makes up from 60 to 100 percent of the areas of this complex and Bonilla, from 0 to 40 percent. Most areas also contain some Cresbard soil. Some of the nearly level areas consist entirely of Williams loam. The Williams soil is on low knolls or slopes, and the Bonilla soil is in drainageways and level sites.

The areas of this complex are used for crops or pasture. Wind erosion may occur in fallow fields, but it can be controlled by stubble-mulch tillage. (Capability unit IIc-2; Silty range site)

Williams-Bonilla loams, undulating (WnB) (3 to 5 percent slopes).--Except in slope, this complex of soils is similar to Williams-Bonilla loams, nearly level. Stubble-mulch tillage will help to limit erosion in cultivated fields. (Capability unit IIe-2; Silty range site)

Williams-Cavour loams, nearly level (WpA) (0 to 2 percent slopes).--From 40 to 70 percent of this complex is Williams soil; 20 to 40 percent, Cavour; and 10 to 20 percent, Cresbard, Bonilla, Miranda, and Hoven. Williams loam is on low knolls and gentle slopes, and the other soils are in drainageways and level sites. The Cavour soil has a claypan in the subsoil that retards the growth of roots. Many areas contain many small, shallow depressions that consist of Hoven soil.

The areas of this complex are used for pasture and crops (fig. 18). (Capability unit IIIs-9; Silty range site)

Williams-Cavour loams, undulating (WpB) (3 to 5 percent slopes).--Except for slope, this complex

Figure 18.--Field of sorghum on Williams-Cavour soils.

of soils is similar to Williams-Cavour loams, nearly level. Stubble-mulch tillage will help control erosion in cultivated fields. (Capability unit IIIe-9; Silty range site)

Williams-Eakin complex, undulating (WrA) (3 to 5 percent slopes).--This complex of soils is near the northwestern corner of the county. About 60 percent of it is Williams soil, and 40 percent, Eakin. In some areas the Eakin soil has formed from coarse silt loam, but in other places it has formed from the same kind of material as the Eakin soils in the southern part of the county.

Large areas of this complex are used for crops. Management practices that will control erosion are needed. (Capability unit IIe-2; Silty range site)

Williams-Miranda complex, nearly level (WsA) (0 to 2 percent slopes).--From 40 to 80 percent of this complex is Williams soil; 20 to 40 percent, Miranda; and 10 to 30 percent, Cavour, Cresbard, and Bonilla. Williams loam is on knolls and slopes, and the other soils are along drainageways and in level sites. The Miranda soil has a claypan at or near the surface, and in many places the vegetation is sparse. Much of this soil is in small depressions, a few feet in diameter.

The areas of this complex are used mainly for pasture or hay. (Capability unit IVs-91; Silty range site)

Williams-Miranda complex, undulating (WsB) (3 to 5 percent slopes).--The Williams soil in this complex is more sloping than that of Williams-Miranda complex, nearly level. In cultivated areas, stubble-mulch tillage is needed to control water erosion. (Capability unit IVs-91; Silty range site)

Williams-Sioux complex, undulating (WuB) (3 to 5 percent slopes).--From 60 to 80 percent of this complex is Williams soil; 20 to 30 percent, Sioux soil; and 10 to 30 percent, included soils. The parent material of the Sioux soil is variable, but it generally consists of pockets of gravel in the glacial till.

Most areas of this complex are used for pasture or hay. Grazing should be controlled so that productive grasses are not replaced by weeds. (Capability unit IIe-2; Silty-Shallow Complex range site)

Williams-Sioux complex, rolling (WuC) (6 to 8 percent slopes).--This complex of soils is similar to Williams-Sioux complex, undulating, but it includes Zahl soil that, in places, has a gravelly surface layer. Nearly all areas of this complex are used for pasture. (Capability unit IVe-5; Silty-Shallow Complex range site)

Williams-Sioux complex, hilly (WuD) (9 to 14 percent slopes).--Except for steeper slopes and a greater proportion of Zahl soil, this complex of soils is similar to Williams-Sioux complex, rolling. The areas are used for pasture. (Capability unit VIe-5; Silty-Shallow Complex range site)

Williams-Zahl complex, rolling (WxC) (6 to 8 percent slopes).--From 40 to 70 percent of this complex is Williams soil; 20 to 50 percent, Zahl soil; and 10 percent, included soils. In most places the Zahl soil has a gravelly surface layer. The areas of this complex are used mainly for pasture. (Capability unit IIIe-2; Silty-Shallow Complex range site)

Williams-Zahl loams, rolling (WzC) (6 to 8 percent slopes).--From 40 to 70 percent of this complex is Williams loam; 20 to 50 percent, Zahl loam; and 10 percent, included soils. The surface layer of the Zahl soil is not so gravelly as that of the Zahl soil in Williams-Zahl complex, rolling. Most areas of Williams-Zahl loams, rolling, are used for pasture or hay. (Capability unit IIIe-2; Silty-Shallow Complex range site)

Zahl Series

The Zahl series consists of deep, friable soils that have a thin, dark-colored surface layer. These soils are in all the hilly parts of the county (fig. 19). Because of steep slopes, most areas are used for pasture or hay.

These excessively drained soils have developed in glacial material. This material varies and consists of loam or clay loam with pockets of silt, sand, and gravel. In many places the surface of the Zahl soils is littered with rocks and boulders. The loam surface layer normally is less than 3 inches thick. In some places it overlies a thin subsoil with weak, prismatic structure, and in others it overlies the parent material. The soils are generally calcareous throughout.

Figure 19.--Zahl soils on steep slopes. Some runoff water collects in coves and draws and encourages the growth of trees.

Zahl-Houdek complex, hilly (ZaD) (9 to 14 percent slopes).--The areas of this complex are in the eastern part of the county. Zahl soil makes up approximately 50 percent of the acreage; Houdek, 30 percent; and Bonilla, Cresbard, and Tetonka, 20 percent. In most places the Zahl soil has a gravelly surface layer.

The soils of this complex are used mainly for pasture. Control of grazing will help maintain enough grass to protect the soils from erosion. Many areas have been overgrazed, and some of the more productive grasses have been replaced by short grasses and weeds. If stocking rates were reduced for a few years, however, the better grasses would replace less desirable plants. Seeding is necessary in areas where there are no desirable grasses. (Capability unit VIe-22; Shallow-Silty Complex range site)

Zahl-Houdek loams, hilly (ZhD) (9 to 14 percent slopes).--Except that the Zahl soil has a loam surface layer, this complex is similar to Zahl-Houdek complex, hilly. (Capability unit VIe-22; Shallow-Silty Complex range site)

Zahl-Houdek loams, steep (ZhE) (15 or more percent slopes).--The Houdek soil is on steep slopes and generally has a thin profile. Otherwise, this complex is similar to Zahl-Houdek loams, hilly. The areas are used for pasture. (Capability unit VIe-22; Shallow-Silty Complex range site)

Zahl-Raber complex, hilly (ZmD) (9 to 14 percent slopes).--Approximately 50 percent of this complex is Zahl soil; 30 percent, Raber soil; and 20 percent, Gann and Eakin soils and a gravelly soil similar to those of the Sioux series. In about half the acreage of the Zahl soil, the surface layer is gravelly.

The areas of this complex are used for pasture or hay. (Capability unit VIe-22; Shallow-Silty Complex range site)

Zahl-Raber complex, steep (ZmE) (15 or more percent slopes).--This complex is similar to Zahl-Raber complex, hilly, except that the soils are steeper and more susceptible to erosion if overgrazed. (Capability unit VIe-22; Shallow-Silty Complex range site)

Zahl-Raber loams, hilly (ZrD) (9 to 14 percent slopes).--Except that the surface layer of the Zahl soil is generally of loam texture, this complex is similar to Zahl-Raber complex, hilly. The areas are used for pasture or hay. (Capability unit VIe-22; Shallow-Silty Complex range site)

Zahl-Raber loams, steep (ZrE) (15 or more percent slopes).--This complex is similar to Zahl-Raber loams, hilly, but the steeper slopes are more susceptible to erosion if the grass cover is destroyed by overgrazing. (Capability unit VIe-22; Shallow-Silty Complex range site)

Zahl and Sioux soils, hilly (ZsD) (9 to 14 percent slopes).--Approximately 50 percent of this undifferentiated unit is Zahl gravelly loam; 20 percent, Sioux soil; and 30 percent, included soils. The included soils, which vary according to the locations of the areas, are Houdek, Williams, or

Raber or soils generally associated with them. The Sioux soil normally has developed from pockets of gravel in the glacial till.

The areas of Zahl and Sioux soils, hilly, are used mainly for pasture. (Capability unit VIe-22; Shallow range site)

Zahl and Sioux soils, steep (ZsE) (15 or more percent slopes).--These soils are less productive than Zahl and Sioux soils, hilly. The areas are used for pasture. (Capability unit VIe-22; Shallow range site)

Zahl-Williams complex, hilly (ZxD) (9 to 14 percent slopes).--Approximately 50 percent of this complex is Zahl gravelly loam; 30 percent, Williams soil; and 20 percent, Gann and Bonilla soils and a soil formed from gravel that is similar to the Sioux soils. The areas are used for pasture. (Capability unit VIe-22; Shallow-Silty Complex range site)

Zahl-Williams complex, steep (ZxE) (15 or more percent slopes).--Except for the steep slopes, this complex is similar to Zahl-Williams complex, hilly. Grazing should be controlled so that productive grasses are not replaced by weeds. (Capability unit VIe-22; Shallow-Silty Complex range site)

Zahl-Williams loams, hilly (ZyD) (9 to 14 percent slopes).--Except that the Zahl soil is of loam texture, this complex is similar to Zahl-Williams complex, hilly. The areas are used for pasture. (Capability unit VIe-22; Shallow-Silty Complex range site)

Zahl-Williams loams, steep (ZyE) (15 or more percent slopes).--Except for slope, this complex is similar to Zahl-Williams loams, hilly. (Capability unit VIe-22; Shallow-Silty Complex range site)

Use and Management of the Soils

In this section, general farming practices are first discussed. Next, the land capability classification used by the Soil Conservation Service is described. Following this, management of the soils by capability units and the estimated yields of crops on soils suited to cultivation are given. Then there is a section on range management and one on engineering uses of the soils.

Soil Management Practices[3]

The main problems of management in Hand County are the conservation of moisture and the control of erosion. The practices to be used in producing crops are designed to help solve these problems. First discussed are the practices generally desirable in growing crops, and then the effect of these and other special practices, such as stripcropping and stubble-mulch tillage, on the control of water and wind erosion.

[3] By F. E. Shubeck, associate agronomist, and L. F. Puhr, agronomist, South Dakota State College.

Cultural practices

Under this heading, the following management needs are discussed in order: Moisture conservation, cropping systems, maintaining soil organic matter, use of commercial fertilizers, and tillage methods.

MOISTURE CONSERVATION

The conservation and efficient use of water from precipitation are especially important in Hand County. An additional inch of rainfall produces an additional 3 or 4 bushels of wheat per acre when there is enough annual precipitation to prevent a crop failure. Yields of crops depend largely on how efficiently rainfall is stored and used. The amount of water stored in the soil is influenced by the infiltration rate and the rate of evaporation from the surface (see the discussion under the heading "Tillage Methods"), by the use of moisture-conserving crops in the cropping system, and by the amount of water used by weeds.

Summer fallow helps to add to the supply of soil moisture. Under clean fallow, 20 to 25 percent of the precipitation is stored in the soils, except sandy ones, which cannot hold large amounts of water. Summer-fallow tillage is effective only if weeds are destroyed while the surface is left resistant to water and wind erosion.

The use of moisture by weeds is a serious problem in Hand County. A fairly light infestation of lambsquarters or sunflowers will use moisture that could produce 6 to 8 bushels of corn per acre. Detailed information on weed control can be obtained through the local soil and water conservation district, the office of the county extension agent, or South Dakota State College.

CROPPING SYSTEMS

A good cropping system is the foundation of a sound fertility and soil conserving program. As markets and prices change, the cropping system can be changed to fit prevailing conditions. The major crops suited to the soils of Hand County are corn, wheat, flax, alfalfa, and sweetcover. See the county extension agent or a representative of the local soil and water conservation district for suggestions on suitable crops for your soils.

MAINTAINING SOIL ORGANIC MATTER

Maintaining or increasing the supply of organic matter in the soils of Hand County is important. Organic matter serves as a storehouse for plant nutrients that are gradually released as the organic matter decomposes. It improves the general tilth of the soil, increases the water-holding and water-absorbing capacities, promotes better soil structure, and indirectly reduces the losses by wind and water erosion.

Organic matter can be added to the soil by plowing under crop residues, by applying barnyard manure, and by growing green-manure crops. The burning of straw or overgrazing, however, destroys potential organic matter.

Barnyard manure supplies plant nutrients as well as organic matter. A ton of manure contains approximately 10 pounds of nitrogen, 5 pounds of phosphorus (P_2O_5), 10 pounds of potassium (K_2O), and small amounts of several trace elements. On farms that have a limited amount of livestock, green-manure crops, grasses, or legumes are needed in the cropping system to maintain organic matter. Inoculated legumes are the best green-manure crops for improving the supply of nitrogen, because with the aid of symbiotic micro-organisms, they obtain a large part of their nitrogen from the air.

USE OF COMMERCIAL FERTILIZERS

In Hand County the content of plant nutrients in the soil varies according to the kind of soil and its cropping history. Soils that have been intensively cultivated to small grain and corn, without the addition of barnyard manure, crop residues, or green manure, are most apt to need fertilizer. Also, eroded soils usually are more in need of fertilizer than similar soils that are not eroded.

In general, nitrogen is the most deficient element in the soils of the county. Phosphorus is generally needed for maximum yields of alfalfa and other crops and for advancing the date of maturity of some crop varieties. The response to phosphorus, however, is usually greater in the eroded soils or those that are heavily cropped.

At present, most soils have no appreciable need for commercial potash. Most of the soils are well supplied with all the minor and trace elements necessary for the growth of plants.

If there is enough rainfall, corn will respond to nitrogen fertilizer on soils in which the fertility has been decreased through the growing of continuous cash-grain crops. Nevertheless, in Hand County, yields of corn are limited more often by the climate than by lack of soil fertility.

It is more economical to use commercial fertilizer for small grain crops than for corn. Nitrogen is the most limiting element. Nitrogen fertilizer, however, will not increase yields of small grain if legumes, manure, or summer fallow have supplied enough nitrogen.

When grown without legumes, grasses often respond to nitrogen fertilizer. On most soils on which grasses are grown, yields of seed and forage can be increased substantially through the addition of nitrogen. Cool season native grasses will respond to nitrogen.

A soil-testing laboratory is maintained by the Agronomy Department of South Dakota State College. Samples of soil that are sent to the laboratory are analyzed to determine the supply of available nutrients. Additional information on soil testing and on the use of commercial fertilizer can be obtained from the local soil and water conservation district or from the county extension agent.

TILLAGE METHODS

Proper tillage helps to conserve moisture in the soil by increasing the rate of infiltration and by reducing the loss of moisture caused by runoff, evaporation, and weeds.

Results of a study by Duley and Russel (2) indicate that protecting the soil by plant residues may be more effective than "black fallow" for increasing infiltration and reducing evaporation losses. The value of maintaining a dust mulch of pulverized soil on the surface to reduce evaporation has been somewhat overemphasized. Because of the hazard of severe wind erosion, this is a dangerous practice.

Only enough tillage to accomplish the desired purpose should be used. Too much cultivation breaks down the cloddy structure of the soil, reduces the amount of surface residue, and smooths the surface. As a result, the soil becomes more susceptible to wind and water erosion. Tillage operations should destroy weeds, yet leave the surface in a condition to absorb water and resist erosion. Stubble-mulch tillage usually fulfills these requirements.

Many improvements have been made in implements that are suitable for stubble-mulch tillage. Some of these implements are the one-way disk, the rodweeder, the duckfoot cultivator, chisel tools, and blade machines.

Control of erosion

Erosion is a constant problem on the soils of Hand County. Practices needed for its control are discussed next. Additional information on the control of erosion can be obtained from the local soil and water conservation district, the county extension agent, or South Dakota State College.

PRACTICES FOR THE CONTROL OF WIND EROSION

Wind erosion can be controlled by maintaining a vegetative cover to reduce the velocity of the wind and by the use of emergency tillage to trap moving soil.

Any device that reduces the velocity of the wind will result in an even greater reduction in wind pressure on the soil. If a stubble of straw, sorghum, or sudangrass, 10 to 12 inches high, is left on a field, the wind velocity and pressure will be effectively reduced at the surface of the soil. The stubble will also help to collect blowing snow and thereby conserve moisture.

Stripcropping and the use of shelterbelts are other methods of reducing the velocity of the wind. Strips should be laid out at right angles to the prevailing winds that blow from northwest to southeast. Shelterbelts do not become effective in reducing wind velocity until several years after the trees are planted. The width of the area protected on the windward side of the shelterbelt is about 5 times the height of the shelterbelt, and the width of the area protected on the leeward side is 20 to 30 times the height of the shelterbelt.

Once wind erosion has started, listing is an emergency measure effectively used to trap moving soil. The duckfoot cultivator or field cultivator will produce a cloddy surface that helps to reduce soil drifting. But if these implements bring up only loose, dry, pulverized soil, they may do more harm than good. Emergency tillage gives only temporary relief and should be used only as a

stopgap measure until a plant cover can be established. Emergency cover crops, such as grain sorghum, sweet sorghum, sudangrass, or millet, should be planted as soon as there is enough moisture in the soil.

PRACTICES FOR THE CONTROL OF WATER EROSION

Various practices are used to protect the soils of Hand County from water erosion. On long, continuous slopes, erosion can be controlled by terraces, contour stripcropping, stubble-mulch tillage, and grassed waterways. Short, discontinuous slopes are not well suited to contour farming, but on these slopes erosion can be controlled by keeping the soil in legumes and grasses a great part of the time or by using stubble-mulch tillage. Such crops provide protective cover and also add organic matter to the soil. The additional organic matter improves the soil structure and, consequently, increases the rate of infiltration, reduces the amount of runoff, and restricts erosion. A soil high in organic matter has a large proportion of aggregates that are not destroyed by rapidly moving water.

Capability Groups of Soils

The capability classification is a grouping of soils that shows, in a general way, how suitable they are for most kinds of farming. It is a practical grouping based on limitations of the soils, the risk of damage when they are used, and the way they respond to treatment.

In this system all the kinds of soil are grouped at three levels, the capability class, subclass, and unit. The eight capability classes in the broadest grouping are designated by Roman numerals I through VIII. In class I are the soils that have few limitations, the widest range of use, and the least risk of damage when they are used. The soils in the other classes have progressively greater natural limitations. In class VIII are soils and landforms so rough, shallow, or otherwise limited that they do not produce worthwhile yields of crops, forage, or wood products.

The subclasses indicate major kinds of limitations within the classes. Within most of the classes, there can be up to four subclasses. The subclass is indicated by adding a small letter, e, w, s, or c, to the class numeral, for example, IIe. The letter e shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; w means that water in or on the soil will interfere with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); s shows that the soil is limited mainly because it is shallow, droughty, or stony, and c, used in only some parts of the country, indicates that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few or no limitations. Class V can contain, at the most, only subclasses w, s, and c, because the soils in it have little or no erosion hazard but have other limitations that limit their use largely to pasture, range, woodland, or wildlife.

Within the subclasses are the capability units, groups of soils enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally identified by numbers assigned locally, for example, IIe-2 or IIIe-2.

Soils are classified in capability classes, subclasses, and units in accordance with the degree and kind of their permanent limitations; but without consideration of major and generally expensive landforming that would change the slope, depth, or other characteristics of the soil; and without consideration of possible but unlikely major reclamation projects.

The eight classes in the capability system, and the subclasses and units in this county, are described in the list that follows. The numbering of capability units in Hand County is based on a statewide system. Not all of the capability units used in the State are needed in this county; and, consequently, the numbering of units in the county is not necessarily consecutive.

Class I. Soils that have few limitations that restrict their use.

(No class I soils in Hand County, because of slight climatic limitations.)

Class II. Soils that have some limitations that reduce the choice of plants or require moderate conservation practices.

Subclass IIe. Soils subject to moderate erosion if they are not protected.

Capability unit IIe-2.--Deep, dark-colored, gently sloping soils that are moderately permeable, medium textured, and well drained to moderately well drained.

Subclass IIw. Soils that have moderate limitations because of excess water.

Capability unit IIw-1.--Deep, dark-colored, nearly level soils that are medium textured and well drained to somewhat poorly drained.

Subclass IIs. Soils that have moderate limitations of moisture capacity or tilth.

Capability unit IIs-1.--Deep, dark-colored, nearly level soils that are slowly permeable, fine and moderately fine textured, and well drained to moderately well drained.

Subclass IIc. Soils that have a slight climatic limitation.

Capability unit IIc-2.--Deep, dark-colored, nearly level soils that are moderately permeable, medium and moderately fine textured, and well drained to moderately well drained.

Class III. Soils that have severe limitations that reduce the choice of plants, or require special conservation practices, or both.

Subclass IIIe. Soils subject to severe erosion if they are cultivated and not protected.

Capability unit IIIe-1.--Deep to moderately shallow, dark-colored, gently sloping, well-drained soils that are slowly permeable and fine to moderately fine textured.

Capability unit IIIe-2.--Deep, dark-colored, moderately permeable, medium-textured, well-drained soils on rolling or sloping topography.

Capability unit IIIe-5.--Deep, medium-textured, well drained to moderately well drained, undulating soils that are moderately shallow to gravel.

Capability unit IIIe-9.--Deep, dark-colored, medium-textured, well-drained, undulating soils; some soils have a claypan.

Subclass IIIs. Soils that have severe limitations of moisture capacity or tilth.

Capability unit IIIs-5.--Dark-colored, medium-textured, moderately well drained to somewhat poorly drained, nearly level soils that are moderately shallow to gravel.

Capability unit IIIs-9.--Deep, dark-colored, nearly level soils; some soils have a claypan.

Class IV. Soils that have very severe limitations that restrict the choice of plants, require very careful management, or both.

Subclass IVe. Soils subject to very severe erosion if they are cultivated and not protected.

Capability unit IVe-1.--Deep to moderately shallow, dark-colored, sloping soil that is slowly permeable, fine textured, and well drained.

Capability unit IVe-3.--Deep, moderately sandy, well-drained miscellaneous land type that has moderately rapid permeability.

Capability unit IVe-4.--Deep, dark-colored, nearly level to gently sloping, well-drained sandy soil.

Capability unit IVe-5.--Deep to moderately shallow, medium- and coarse-textured soils on rolling topography.

Subclass IVw. Soils that have very severe limitations for cultivation, because of excess water.

Capability unit IVw-11.--Deep, dark-colored, moderately fine textured, poorly drained, nearly level soil.

Capability unit IVw-9.--Deep, dark-colored, somewhat poorly drained soil that frequently has a high water table.

Sublcass IVs. Soils that have very severe limitations of stoniness, low moisture-holding capacity, or other soil features.

Capability unit IVs-6.--Dark-colored, medium-textured, nearly level to undulating soils underlain at a shallow depth by gravel.

Capability unit IVs-91.--Deep, dark-colored, medium textured to moderately fine textured, nearly level to undulating soils, some of which have a claypan.

Class V. Soils not likely to erode that have other limitations, impractical to remove without major reclamation, that limit their use largely to pasture or range, woodland, or wildlife food and cover.

Subclass Vw. Soils too wet for cultivation; drainage or protection not feasible.

Cabability unit Vw-1.--Dark-colored, poorly drained soil in depressions.

Class VI. Soils that have severe limitations that make them generally unsuitable for cultivation and that limit their use largely to pasture or range, woodland, or wildlife food and cover.

Subclass VIe. Soils severely limited, chiefly by risk of erosion, if protective cover is not maintained.

Capability unit VIe-1.--Moderately steep, fine-textured soils that have a thin, dark-colored surface layer.

Capability unit VIe-22.--Deep, medium textured and moderately fine textured, hilly to steep soils that have a thin, dark-colored surface layer.

Capability unit VIe-5.--Deep, medium- and coarse-textured, hilly soils.

Capability unit VIe-6.--Deep, steep miscellaneous land types formed from gravel, glacial till, and shale.

Subclass VIw. Soils severely limited by excess water and generally unsuitable for cultivation.

Capability unit VIw-9.--Miscellaneous land type that is saline and occasionally has a high water table.

Capability unit VIw-19.--Moderately fine textured claypan soil in depressions.

Subclass VIs. Soils generally unsuitable for cultivation and limited for other uses by their moisture capacity, stones, or other features.

Capability unit VIs-1.--Deep, fine-textured, very slowly permeable, level soil that, in some places, has a claypan.

Capability unit VIs-91.--Deep, nearly level to undulating soils, most of which have a claypan.

Class VII. Soils that have very severe limitations that make them unsuitable for cultivation without major reclamation, and that restrict their use largely to grazing, woodland, or wildlife. (No class VII soils in Hand County.)

Class VIII. Soils and landforms that have limitations that preclude their use, without major reclamation, for commercial production of plants; and restrict their use to recreation, wildlife, water supply, or esthetic purposes. (No class VIII soils in Hand County.)

Management by capability units

Each of the capability units in Hand County is discussed in the following pages. All of the soils of one unit have essentially the same limitations, are suitable for the same crops, and need about the same kind of management. The use of the soils for rangeland is discussed in detail in the section "Range Management."

CAPABILITY UNIT IIe-2

The soils of this capability unit are deep, dark colored, gently sloping, moderately permeable, and medium textured. They are well drained to moderately well drained.

These soils are moderately susceptible to runoff and water erosion. They do not have quite so thick

a surface layer as the soils of capability unit IIc-2. The soils in unit IIe-2 are--

EaB Eakin association, undulating.
ErB Eakin-Raber complex, undulating.
GaB Gann silt loam, gently sloping.
HbB Hand loam, undulating.
HhB Houdek loam, undulating.
HkB Houdek-Bonilla loams, undulating.
HsB Houdek-Sioux complex, undulating.
LnB Lane loam, gently sloping.
RaB Raber loam, undulating.
ReB Raber-Eakin complex, undulating.
WmB Williams loam, undulating.
WnB Williams-Bonilla loams, undulating.
WrA Williams-Eakin complex, undulating.
WuB Williams-Sioux complex, undulating.

The soils in this unit are suitable for all crops normally grown in the county, but, because of the danger of erosion, they should not be used continuously for intertilled crops. These soils, especially those in the western and southern parts of the county, are used more for pasture and hay crops than the soils of unit IIc-2.

In cultivated areas, stubble-mulch tillage will help to reduce erosion and to increase the intake of water. Because most slopes are short, farming on the contour may not be practical. Some gently sloping areas of Gann and Lane soils, however, are extensive enough for contouring.

Crops grown on the soils of this unit respond to fertilizer in about the same way as those grown on soils of unit IIc-2.

CAPABILITY UNIT IIw-1

The soils of capability unit IIw-1 are deep, dark colored, nearly level, medium textured, and well drained to somewhat poorly drained. These soils are--

LlA LaDelle-Lamoure silt loams, nearly level.

The LaDelle soil is on benches along streams and is dominantly well drained. The Lamoure soil is on stream bottoms and in low areas that may have a high water table. Unless this soil is artificially drained, yields of cultivated crops will be low during some years.

Most areas of the soils of this capability unit are used for pasture or hay, because they have been cut into small tracts by meandering streams.

Grazing should be controlled so that deep-rooted native tall grasses are not replaced by short grasses and weeds with shallow root systems. In areas where the water table is high, alfalfa and other deep-rooted legumes obtain additional moisture from the substratum, and, as a result, yields are good. In some areas, legumes respond well to phosphate fertilizer. The amount of fertilizer needed should be determined by soil tests.

CAPABILITY UNIT IIs-1

This capability unit is made up of deep, dark-colored, nearly level soils that are slowly permeable, fine and moderately fine textured, and well drained to moderately well drained. These soils have a silty clay loam or silty clay profile. During winter the surface layer becomes loose and granular and is very susceptible to wind erosion. The soils in this unit are--

LcA LaDelle silty clay loam, nearly level.
LdA LaDelle silty clay loam, fans, nearly level.
LoA Lane silty clay, nearly level.
OrA Orman silty clay, nearly level.

Large areas of these soils are used for crops. The LaDelle soils are slightly more suitable for corn, and the Lane and Orman soils are normally more suitable for small grain, grain sorghum, and hay crops. The soils of this unit are more productive in the northeastern part of the county, because of more favorable climate.

Stubble-mulch tillage helps to control erosion and returns residues to the soils. Even though all residues are returned, the soils will puddle if tilled when too wet. In eroded fields, crop yields can be increased through the addition of nitrogen fertilizer and possibly phosphate.

CAPABILITY UNIT IIc-2

The soils of this capability unit are deep, dark colored, nearly level, moderately permeable, and medium and moderately fine textured. They are well drained to moderately well drained. These soils have no serious limitations, except for the climate. There is not enough rainfall during summer for maximum yields of crops. The soils in this unit are--

Ag Agar association.
BcA Bonilla-Cresbard loams, nearly level.
BhA Bonilla-Houdek loams, nearly level.
EaA Eakin association, nearly level.
ErA Eakin-Raber complex, nearly level.
GaA Gann silt loam, nearly level.
HbA Hand loam, nearly level.
HhA Houdek loam, nearly level.
HkA Houdek-Bonilla loams, nearly level.
LaA LaDelle loam, nearly level.
LbA LaDelle silt loam, nearly level.
RaA Raber loam, nearly level.
ReA Raber-Eakin complex, nearly level.
WnA Williams-Bonilla loams, nearly level.

Most areas of these soils are used for crops. Corn can be grown most profitably in the northeastern part of the county, which receives the greatest amount of rainfall. Much of the corn grown in drier areas is cut for silage or fodder. Small grain matures early and, consequently, has a better chance of escaping summer droughts than corn.

Water erosion is a minor problem, but wind erosion may be severe during droughts and also early in spring when fields do not have a protective cover. The soils in drainageways and in swales dry slowly, and, if they are tilled when wet, the surface may become puddled.

Stubble-mulch tillage helps to control erosion and returns residues to the soils. The residues promote desirable structure in the surface layer and add plant nutrients to the soils. Crops respond to fertilizer only in years when the supply of moisture is favorable. All grain crops generally respond to nitrogen fertilizer, and, during some seasons, small grain responds to phosphate.

CAPABILITY UNIT IIIe-1

The soils of this capability unit are deep to moderately shallow, dark colored, gently sloping, and well drained. They are also slowly permeable and fine to moderately fine textured and, therefore, absorb water at a moderately slow rate. Consequently, some rainwater runs off and causes erosion. If the soils are cultivated when wet, the surface will puddle. The soils in this unit are--

MyB Mondamin silty clay loam, gently sloping.
OrB Orman silty clay, gently sloping.
PrB Promise silty clay, gently sloping.

Large areas of these soils are used for crops. Small grain, grain sorghum, and hay crops are generally more profitable than corn.

Intertilled crops do not protect the soils from water erosion as well as small grain or hay crops. Stubble-mulch tillage and the return of crop residues will protect the soils from both wind and water erosion, promote desirable structure, and increase the intake of water. Areas that have long, continuous slopes should be farmed on the contour. In eroded areas, yields of small grain can be increased through the use of nitrogen fertilizer and possibly phosphate.

CAPABILITY UNIT IIIe-2

The soils of this capability unit are deep, dark colored, moderately permeable, medium textured, and well drained. They have rolling or sloping topography. These soils have a thin surface layer, and they are not very fertile. Erosion is severe in areas that are not protected by vegetation. The soils in this unit are--

HhC Houdek loam, rolling.
HtD Houdek-Zahl complex, rolling.
HuD Houdek-Zahl loams, rolling.
RaC Raber loam, rolling.
ReC Raber-Eakin complex, rolling.
RpC Raber-Zahl complex, rolling.
RrC Raber-Zahl loams, rolling.
WmC Williams loam, rolling.
WxC Williams-Zahl complex, rolling.
WzC Williams-Zahl loams, rolling.

Most areas of these soils are used for range or for hay crops, although other crops common to the county can be grown. Small grain and hay crops are more successful than corn. Crop yields tend to be low because much of the water from precipitation runs off and little of it is stored in the soils. Yields are lower in the southern and western parts of the county than in the northeastern part, which receives more rainfall.

Stubble-mulch tillage helps to prevent water and wind erosion. Crop residues that are returned to the soils promote desirable structure and increase the intake of water. Most areas do not have continuous slopes, and, therefore, contouring is not practical. Terraces may help to reduce runoff in some pastures and to decrease flooding in adjacent lower lying areas. In some places, grassed waterways are needed to control erosion. Pastures that contain only undesirable plants should be reseeded to native plants, and the stocking rate should be reduced.

CAPABILITY UNIT IIIe-5

This capability unit consists of deep, medium-textured, well drained to moderately well drained, undulating soils that are moderately shallow to gravel. The substratum of these soils has a low water-holding capacity. The loam surface soil is very susceptible to wind erosion unless protected by growing vegetation or crop residues. Water erosion may be a problem in some of the more sloping areas. The soils in this unit are--

OaB Oahe loam, undulating.
WeB Wessington loam, undulating.

Crops common to the county can be grown successfully on these soils. Small grain and hay crops do better than corn. They mature early and do not depend so much on substratum moisture during summer droughts. Corn grows better on the Wessington soil, which is in the northeastern part of the county, than on the Oahe soil, which is in other parts.

Stubble-mulch tillage will reduce wind and water erosion and increase the amount of water that is absorbed by the soils. On some slopes contour farming and terracing are needed to control erosion and to reduce runoff. Applications of nitrogen fertilizer, and possibly phosphate, will increase yields in eroded areas and in fields that have been farmed for a long time.

CAPABILITY UNIT IIIe-9

The soils of this capability unit are deep, dark colored, medium textured, well drained, and undulating. Some of them have a claypan. The soils of this unit are susceptible to water and wind erosion. The Cavour soils have a slowly permeable claypan in the subsoil. Consequently, they dry slowly after periods of heavy rainfall and tend to be droughty when there is little rainfall. If these soils are tilled too deeply, the friable surface layer becomes mixed with the claypan. The surface layer will then become less friable and more susceptible to puddling. The soils in this unit are--

EcB Eakin-Cavour complex, undulating.
HlB Houdek-Cavour loams, undulating.
RcB Raber-Cavour loams, undulating.
WpB Williams-Cavour loams, undulating.

All crops common to the county can be grown successfully on these soils. The average yields, however, are somewhat limited because of the claypan in the Cavour soils. Small grain is less adversely affected than corn by the claypan. Soils of this unit in the western and southern parts of the county are used mainly for range and for hay crops. Those in the northeastern part are used for cultivated crops and range.

Stubble-mulch tillage will help to control water and wind erosion. The return of crop residues to the soils will improve the tilth of the surface layer. Stocking rates on pastures should be controlled so that short grasses and weeds do not become established. In pastured areas, western wheatgrass is affected less than other mid grasses by the claypan.

CAPABILITY UNIT IIIs-5

This capability unit is made up of dark-colored, medium-textured, nearly level soils that are moderately shallow to gravel. These soils are moderately well drained to somewhat poorly drained. Because their substratum is gravelly, they have a limited water-holding capacity. Wind erosion may be severe in fields that lack a protective cover of vegetation. Water erosion is not a problem, because the soils are very permeable and have little runoff. The soils of this unit are--

OaA Oahe loam, nearly level.
SyA Spottswood loam, nearly level.
WeA Wessington loam, nearly level.

These soils can be used for the crops normally grown in the county, but yields may be low because of the gravelly substratum. Small grain is grown more successfully than corn. It matures early in the summer, whereas corn must depend on subsoil moisture during droughts late in summer.

CAPABILITY UNIT IIIs-9

The soils of this capability unit are deep, dark colored, and nearly level. Some of them have a slowly permeable claypan, generally below plow depth, that limits the penetration of roots. Wind erosion may be a problem in fields that lack a protective cover of vegetation. In some areas, surface drainage would improve crop yields. The soils in this unit are--

CrA Cresbard-Bonilla loams, nearly level.
CsA Cresbard-Cavour silt loams, nearly level.
EcA Eakin-Cavour complex, nearly level.
HlA Houdek-Cavour loams, nearly level.
LeA LaDelle-Aberdeen silty clay loams, nearly level.
LpA Lane-Exline silty clay loams, nearly level.
LrA Lane-Exline silty clays, level.
RcA Raber-Cavour loams, nearly level.
SxA Spottswood complex, nearly level.
WpA Williams-Cavour loams, nearly level.

These soils can be used to grow all crops common to the county. Small grain is less adversely affected than corn by the claypan that occurs in some of these soils. Most of the soils have a saline substratum that reduces the thickness of the root zone.

Stubble-mulch tillage helps to control wind erosion and returns crop residues to the soils. The residues help to maintain favorable tilth, provided the claypan is not mixed with the surface layer during tillage. The claypan soils are in many of the low-lying positions and areas along drainageways that are wet for short periods. In these places, drainage ditches may be needed to remove excess surface water.

Wind erosion can be controlled through stubble-mulch tillage. In eroded areas, yields can be improved through the application of nitrogen fertilizer and possibly phosphate.

CAPABILITY UNIT IVe-1

The soil in this capability unit is deep to moderately shallow, dark colored, slowly permeable, fine textured, well drained, and sloping. It is--

PrC Promise silty clay, sloping.

This soil absorbs water slowly, and, as a result, part of the rainwater runs off. Erosion is a problem unless the surface is protected by vegetation. During winter the surface layer becomes loose and granular, and it is very susceptible to wind erosion. Consequently, this soil is probably best used for pasture. Grazing should be limited so that a protective cover is maintained.

If cultivated, this sloping soil is subject to additional erosion, especially if intertilled crops are grown too often. Small grain and hay can be grown more successfully than corn.

CAPABILITY UNIT IVe-3

This capability unit consists of a deep, moderately sandy, well-drained miscellaneous land type. Permeability is moderately rapid. This land type is--

Rs Rolling sandy land.

Rolling sandy land varies in different areas. In all areas, however, it has a sandy or gravelly subsoil that is droughty. Because of the strong slope, this land type is subject to water erosion. Those areas that have a sandy surface layer are susceptible to wind erosion when they lack a protective cover.

Most areas can be used most profitably for range or native hay. On areas that are cultivated, small grains and hay crops should be grown, as they provide protection against erosion.

CAPABILITY UNIT IVe-4

The soil in this capability unit is deep, dark colored, nearly level to gently sloping, well drained, and sandy. It is--

Ma Maddock sandy loam.

This soil has a subsoil of loamy sand. Where the surface layer has eroded away, the subsoil is very susceptible to wind erosion.

The Maddock soil is suitable for most crops grown in the county, but it is probably best used for pasture, hay, or small grain, which provide more protection against wind erosion.

In cultivated areas, stubble-mulch tillage helps to control erosion. Many pastures that contain short grasses and weeds need to be reseeded to more productive plants.

CAPABILITY UNIT IVe-5

This capability unit is made up of deep to moderately shallow, medium- and coarse-textured soils on rolling topography. These soils are susceptible to erosion. In each area mapped, there are soils that are gravelly, have a low water-holding capacity, and are droughty. The soils in this unit are--

HsC Houdek-Sioux complex, rolling.
WuC Williams-Sioux complex, rolling.

Most areas of these soils are used for hay crops or range, but all crops common to the county can be grown. Much of the water from precipitation runs off, and, consequently, crop yields are low. Because they provide more protection against erosion, small grain and hay crops should be grown instead of intertilled crops.

Stubble-mulch tillage helps to protect the soils from water and wind erosion. Most cultivated

areas do not have continuous slopes, and, therefore, they are not suitable for contour farming and terracing. Terraces might help to reduce runoff in some pastures and to decrease flooding in the adjacent lower lying areas. In cultivated areas, grassed waterways may be needed to control gully erosion. Range that contains undesirable plants and produces low yields of forage should be reseeded to suitable plants.

CAPABILITY UNIT IVw-11

The soil in this capability unit is deep, dark colored, moderately fine textured, poorly drained, and nearly level. It is--

LmA Lamoure silty clay loam, nearly level.

This soil occasionally has a high water table, and, as a result, yields of crops may be limited. Many native grasses on this soil are not damaged by the high water table and are very productive of pasture and hay. Most areas have been overused, however, and the desirable native grasses have been replaced by short grasses that have shallow root systems. In some areas of this soil, the water table is more or less permanently in the substratum. These places are rarely flooded, and they can be used profitably for alfalfa.

CAPABILITY UNIT IVw-9

This capability unit consists of deep, dark colored, somewhat poorly drained soils that frequently have a high water table. The soils are--

HaA Hamerly loam, nearly level.

Tw Tetonka silt loam, somewhat poorly drained.

In most years, areas of these soils are wet during part of the spring and the early part of summer. Planting of crops must be delayed until the soils dry. If the soils are tilled when too wet, their surface layer will become compact.

Most areas of these soils are in small, shallow depressions, and it is not practical to cultivate them as separate fields. Much of the acreage can be used profitably for hay crops or as wildlife habitats.

CAPABILITY UNIT IVs-6

The soils of this capability unit are dark colored, medium textured, and nearly level to undulating. They are underlain at a shallow depth by gravel. The gravelly subsoil and substratum in these soils do not hold large amounts of moisture. Consequently, yields of crops are low. Wind erosion is a hazard if the soils are not protected by a cover of vegetation. The soils in this unit are--

OhA Oahe-Sioux loams, nearly level.
OhB Oahe-Sioux loams, undulating.
Sm Sioux loam.
So Sioux-Oahe loams.
Sw Sioux-Wessington loams.
WgA Wessington-Sioux loams, nearly level.
WgB Wessington-Sioux loams, undulating.

These soils can be used for all crops normally grown in the county. Small grain and hay crops are most suitable. They mature early in the season when rainfall is greatest and, therefore, do not depend on subsoil moisture so much as corn.

Stubble-mulch tillage will help protect the soils from wind and water erosion. The return of crop residues to the soil will replenish the supply of organic matter and thus increase the water-holding capacity.

Many pastures have been overused, and, as a result, short grasses and weeds have increased. These pastures need to be reseeded to more productive plants.

CAPABILITY UNIT IVs-91

The soils of this capability unit are deep, dark colored, medium textured to moderately fine textured, and nearly level to undulating. Some of these soils have a claypan. In the Cavour and Cresbard soils, the claypan is generally below the depth reached by the plow; in the Exline, Harriet, and Miranda soils, however, it is within plow depth. The slowly permeable claypan restricts the penetration of moisture, and it dries slowly after being saturated. The roots of most plants have difficulty in penetrating the claypan and do not grow well in the saline substratum. The soils in this capability unit are--

CaA Cavour complex, nearly level.
CcA Cavour-Cresbard silt loams, nearly level.
CeA Cavour-Eakin complex, nearly level.
ChA Cavour-Houdek loams, nearly level.
ChB Cavour-Houdek loams, undulating.
CmA Cavour-Raber silt loams, nearly level.
CnA Cavour-Williams loams, nearly level.
EmA Eakin-Miranda complex, nearly level.
EmB Eakin-Miranda complex, undulating.
EvA Exline-Lane silty clay loams, nearly level.
ExA Exline-Lane silty clays, level.
HmA Houdek-Miranda complex, nearly level.
HmB Houdek-Miranda complex, undulating.
LsA Lane-Harriet silty clay loams, nearly level.
RmA Raber-Miranda complex, nearly level.
RmB Raber-Miranda complex, undulating.
WsA Williams-Miranda complex, nearly level.
WsB Williams-Miranda complex, undulating.

The soils of this unit are used for crops and for range. Because of their low moisture-holding capacity, the claypan soils have limited crop yields. On these soils, small grain or hay crops, which mature early in the season, are more suitable than corn.

Some areas need surface drains to remove excess water. The soils with a claypan dry more slowly than the other soils of this unit, and they cannot be tilled soon after heavy rains.

Stubble-mulch tillage will help to protect the soils of this unit from wind and water erosion. The return of crop residues to the soils will help to keep the surface layer friable.

On rangeland, grazing should be limited so that enough vegetation is maintained to protect the claypan soils from wind erosion.

CAPABILITY UNIT Vw-1

This capability unit consists of a dark-colored, poorly drained soil that occurs in depressions. The soil is--

Tp Tetonka silt loam, poorly drained.

The areas of this soil are ponded during part of most growing seasons. Water-tolerant plants were the native vegetation. Because artificial drainage generally is impractical, this soil can best be used for pasture, for hay crops, or as wildlife habitats. Some areas are wet enough so that ducks can nest, but usually the ponds dry up before the ducklings can fly. The areas furnish cover for pheasants and other game common to the uplands.

CAPABILITY UN F VIe-1

This capability unit is made up of moderately steep, fine-textured soils that have a thin, dark-colored surface layer. These soils are--

LtD Lismas-Promise silty clays, hilly.
PrD Promise silty clay, moderately steep.

Because of steep slopes, these soils should be used for range or for hay crops.

CAPABILITY UNIT VIe-22

This capability unit consists of deep, medium textured and moderately fine textured, hilly to steep soils that have a thin, dark-colored surface layer. These soils are--

ZaD Zahl-Houdek complex, hilly.
ZhD Zahl-Houdek loams, hilly.
ZhE Zahl-Houdek loams, steep.
ZmD Zahl-Raber complex, hilly.
ZmE Zahl-Raber complex, steep.
ZrD Zahl-Raber loams, hilly.
ZrE Zahl-Raber loams, steep.
ZsD Zahl and Sioux soils, hilly.
ZsE Zahl and Sioux soils, steep.
ZxD Zahl-Williams complex, hilly.
ZxE Zahl-Williams complex, steep.
ZyD Zahl-Williams loams, hilly.
ZyE Zahl-Williams loams, steep.

These soils are used for range or for hay crops. Because of the steep slopes and danger of erosion, they should not be cultivated.

Grazing should be controlled so that a protective cover of vegetation is maintained. In areas that have been overused, short grasses and weeds have replaced the more productive grasses. In these places grazing should be limited until the more productive plants become reestablished. Some areas may need to be reseeded.

CAPABILITY UNIT VIe-5

The soils of this capability unit are deep, medium- and coarse-textured, and hilly. Because of the hilly topography, they are very susceptible to erosion. Each area contains soils that are gravelly, have a low water-holding capacity, and are droughty. The soils in this unit are--

HsD Houdek-Sioux complex, hilly.
WuD Williams-Sioux complex, hilly.

These soils are used for pasture or for hay crops. They are too hilly to be cultivated. Grazing should be controlled so that there is enough vegetation to protect the soils from erosion.

CAPABILITY UNIT VIe-6

This capability unit consists of deep, steep, miscellaneous land types that formed from gravel, glacial till, and shale. The surface layer is thin. In this unit are--

Hg Hilly gravelly land.
Ru Rough broken land.

These land types are used for range and for hay crops. They are too steep for cultivation.

Grazing should be limited so that there is enough vegetation to prevent erosion. In some areas that have been overused, short grasses and weeds are the main forage plants. In such places, improved management is needed to encourage more desirable plants and to increase productivity.

CAPABILITY UNIT VIw-9

This capability unit consists of a miscellaneous land type that is saline and occasionally has a high water table. The land type is--

Sa Saline alluvial land.

The areas of this land type should be used for pasture or for hay crops. They are not suitable for most cultivated crops.

CAPABILITY UNIT VIw-19

This capability unit consists of a moderately fine textured claypan soil that occurs in depressions. The soil is--

Hv Hoven silty clay loam.

This soil is ponded during rainy periods. It has a dense, very slowly permeable claypan near the surface. Because of the unfavorable structure of the claypan, the soil is unsuitable for cultivated crops. Most areas are used for pasture or for hay crops.

CAPABILITY UNIT VIs-1

The soil in this capability unit is deep, fine textured, very slowly permeable, and level. In some places, it has a claypan. The soil is--

McA McKenzie clay, level.

Nearly all areas of this soil are used for range or for hay crops. Because it is very slowly permeable and clayey, the soil dries slowly following rainy periods. Tilth is poor, and, if the areas are cultivated or grazed when wet, the surface layer will become more compact. The soil is very susceptible to wind erosion if not protected by vegetation.

Drainage ditches will remove excess surface water from parts of some areas. Grazing should be controlled so that the more productive plants are maintained.

CAPABILITY UNIT VIs-91

The soils of this capability unit are deep and nearly level to undulating. Most of them have a claypan near the surface. The claypan has unfavorable structure, is slowly permeable, and dries very slowly after becoming wet. The soils in this unit are--

EsA Exline silty clay, level.
EtA Exline complex, nearly level.
HcA Harriet complex, nearly level.
HdA Harriet-LaDelle silty clay loams, nearly level.
HeA Harriet-Lane silty clay loams, nearly level.

HyA Hurley-Orman silty clays, nearly level.
MdA Miranda complex, nearly level.
MeA Miranda-Eakin complex, nearly level.
MhA Miranda-Houdek complex, nearly level.
MhB Miranda-Houdek complex, undulating.
MrA Miranda-Raber complex, nearly level.
MrB Miranda-Raber complex, undulating.
MwA Miranda-Williams complex, nearly level.

Most areas of these soils are used for range or for hay crops, but some are cultivated. Small grain and hay crops are better suited to soils with a claypan than is corn.

The soils of this unit should be protected from wind erosion by a cover of vegetation or by crop residues. Some gently sloping areas are moderately susceptible to water erosion. This hazard can be controlled by stubble-mulch tillage. All crop residues should be returned to the soil. They will increase the content of organic matter and thus improve tilth. In some areas drainage ditches are needed to remove excess water. Grazing should be controlled so that the desirable forage plants will be dominant.

Estimated Yields

Estimated average acre yields of principal crops grown on soils that are cultivated are given in table 7. The estimated yields, except those of alfalfa hay, are given for two levels of management. In columns A are yields to be expected under common management. In columns B are yields to be expected under improved management that consists of all practices needed to improve yields. Estimated yields for alfalfa hay are given only for the improved management.

Range Management[4]

Nearly 39 percent of Hand County is used for range or for tame pasture. In addition, 15 percent is used to produce alfalfa and tame-grass hay, or mixtures of the two. In the period from 1953 to 1957, the sale of cattle accounted for 43 percent of the gross farm income in the county. The proper management of range and pasture, therefore, is an important part of the agriculture of Hand County.

The discussion that follows pertains primarily to range. The terms "range" and "rangeland" are used to describe naturally occurring grasslands that are used for forage or feed.

Before Hand County was settled, native grasses grew on the soils to which they were best suited. Under natural conditions, the plants that grew on a specific site produced the maximum amount of vegetation and were able to use soil nutrients and moisture efficiently. But when the native vegetation was grazed too much or cut too often for hay, some of the most productive grasses decreased or died out completely. The plants that remained were not so well suited to the soils and thus did not produce so much vegetation. Even native grasses of low productivity yield less when grazed too intensively.

The growth of grass leaves takes place when energy from the sun is combined with carbon dioxide from the air and with water and fertilizer elements from the soil to form sugars and proteins. The grass roots then get from the leaves the materials they need for growth. If the leaves are grazed too close and too often, the roots do not receive enough of these foods to grow extensively and to store enough food reserves for rapid growth of new leaves. The most productive tall grasses are weakened and die if they are repeatedly overgrazed, and the forage plants remaining are the less productive short grasses and weeds. The short grasses will also die if they are grazed too frequently.

On range in poor condition, the vegetation is less effective in reducing runoff, and so less moisture penetrates the soil. In addition, trampling by livestock packs the surface and destroys the loose structure and the natural mulch that promotes infiltration of water. After the soil becomes compact, the amount of runoff increases greatly, less water is retained for the growth of plants, and the danger of erosion increases.

Range sites and condition classes

Different kinds of soils vary in their capacity to produce grasses and other plants for grazing. The soils that will produce about the same kinds and amounts of forage if the range forage is in similar condition make up what is called a range site. A range site is a kind of rangeland that differs significantly from other rangeland in its capacity to produce different kinds and amounts of native vegetation.

Heavy grazing in Hand County has eliminated or at least decreased some of the more productive grasses and forbs. These plants are called decreasers, since they are the first to be destroyed when the range is persistently overgrazed. Less productive plants, known as increasers, become more abundant as the decreasers are crowded out. The increasers are gradually replaced by even less productive plants, known as invaders, if the range is severely overused. The invaders are not part of the natural cover on a specific site, but come in when the condition of the range deteriorates. They are plants from adjacent range sites or plants that have been introduced from other parts of the United States or from foreign countries. Most invaders produce less vegetation and much less forage than native plants. A few invaders, such as Kentucky bluegrass which was introduced into the United States from Europe, are not so productive as the better native grasses, but they are better than the poor native grasses.

Before the range was grazed by livestock, the amount of plants of each kind on a range site remained about the same year after year. During this time, all of the vegetation was native and forage production was high. Changes in the condition of the range that have decreased the amount

[4] Prepared with the assistance of John Farley, range conservationist, Soil Conservation Service.

TABLE 7.--Estimated average acre yields of principal crops grown under two levels of management on soils suited to cultivation

[Yields in columns A are those to be expected under common management and yields in columns B are those to be expected under improved management, provided the climate is similar to the average for the period from 1951 to 1960. Yields are modifications of estimates given in the technical guide of the Soil Conservation Service for South Dakota, by a committee of agronomists including Fred C. Westin, Fred E. Shubeck, Paul L. Carson, Edward J. Langin, and Thomas U. Yager]

Soil	Corn		Spring wheat		Oats		Alfalfa hay
	A	B	A	B	A	B	B
	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Tons
Agar association	23	29	15	19	32	40	1.4
Bonilla-Cresbard loams, nearly level	25	31	15	19	32	40	1.4
Bonilla-Houdek loams, nearly level	26	31	14	17	35	44	1.5
Cavour complex, nearly level	9	11	9	12	20	25	.9
Cavour-Cresbard silt loams, nearly level	14	17	9	12	21	26	1.0
Cavour-Eakin complex, nearly level	14	17	10	13	26	32	1.0
Cavour-Houdek loams, nearly level	14	17	10	13	27	34	1.1
Cavour-Houdek loams, undulating	10	12	10	13	22	27	.9
Cavour-Raber silt loams, nearly level	13	16	10	13	25	31	1.0
Cavour-Williams loams, nearly level	13	16	10	13	26	32	1.0
Cresbard-Bonilla loams, nearly level	15	19	12	15	30	37	1.3
Cresbard-Cavour silt loams, nearly level	15	19	11	14	29	36	1.2
Eakin association, nearly level	21	26	14	17	32	40	1.4
Eakin association, undulating	19	24	12	15	29	36	1.1
Eakin-Cavour complex, nearly level	18	23	12	15	29	36	1.3
Eakin-Cavour complex, undulating	15	19	11	14	25	31	1.0
Eakin-Miranda complex, nearly level	15	19	11	14	27	34	1.2
Eakin-Miranda complex, undulating	14	17	10	13	22	27	.9
Eakin-Raber complex, nearly level	20	25	13	16	31	38	1.3
Eakin-Raber complex, undulating	18	23	11	14	27	34	1.0
Exline silty clay, level	10	12	8	10	17	21	.8
Exline complex, nearly level	10	12	6	8	15	19	.7
Exline-Lane silty clay loams, nearly level	13	16	9	12	19	24	1.0
Exline-Lane silty clays, level	10	12	8	11	19	24	.9
Gann silt loam, nearly level	23	29	15	19	32	40	1.5
Gann silt loam, gently sloping	18	23	11	14	27	34	1.0
Hand loam, nearly level	27	33	14	18	36	45	1.5
Hand loam, undulating	21	26	11	14	30	37	1.2
Harriet-LaDelle silty clay loams, nearly level	8	10	6	8	15	19	.7
Harriet-Lane silty clay loams, nearly level	8	10	5	7	13	16	.7
Houdek loam, nearly level	23	29	13	16	32	40	1.4
Houdek loam, undulating	19	24	10	13	29	36	1.1
Houdek loam, rolling	10	12	6	8	15	19	.9
Houdek-Bonilla loams, nearly level	25	31	14	17	34	42	1.5
Houdek-Bonilla loams, undulating	20	25	12	16	30	37	1.2
Houdek-Cavour loams, nearly level	19	24	12	15	31	38	1.4
Houdek-Cavour loams, undulating	17	21	11	14	27	34	1.0
Houdek-Miranda complex, nearly level	17	21	11	14	27	34	1.3
Houdek-Miranda complex, undulating	15	19	10	13	24	30	.9
Houdek-Sioux complex, undulating	17	21	11	14	25	31	1.1
Houdek-Sioux complex, rolling	9	11	6	8	15	19	.9
Houdek-Zahl complex, rolling	9	11	6	8	15	19	.9
Houdek-Zahl loams, rolling	9	11	6	8	15	19	.9
LaDelle loam, nearly level	23	29	14	17	35	44	1.4
LaDelle silt loam, nearly level	24	30	15	19	37	46	1.5
LaDelle silty clay loam, nearly level	20	25	15	19	32	40	1.4
LaDelle silty clay loam, fans, nearly level	23	29	15	19	35	44	1.5
LaDelle-Aberdeen silty clay loams, nearly level	19	24	13	16	30	37	1.3
LaDelle-Lamoure silt loams, nearly level	20	25	13	16	32	40	1.6
Lane loam, gently sloping	20	25	14	17	27	34	1.2

TABLE 7.--Estimated average acre yields of principal crops grown under two levels of management on soils suited to cultivation--Continued

Soil	Corn		Spring wheat		Oats		Alfalfa hay
	A	B	A	B	A	B	B
	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Tons
Lane silty clay, nearly level	15	19	13	16	25	31	1.4
Lane-Exline silty clay loams, nearly level	14	17	12	15	22	27	1.3
Lane-Exline silty clays, level	13	16	11	14	21	26	1.2
Lane-Harriet silty clay loams, nearly level	10	12	9	11	20	25	1.1
Maddock sandy loam	28	33	10	13	25	31	1.5
Miranda complex, nearly level	6	8	6	8	15	19	.7
Miranda-Eakin complex, nearly level	11	14	8	10	21	26	.8
Miranda-Houdek complex, nearly level	11	14	8	10	22	27	.8
Miranda-Houdek complex, undulating	9	11	7	9	20	25	.8
Miranda-Raber complex, nearly level	10	12	8	10	20	25	.8
Miranda-Raber complex, undulating	8	10	7	9	17	21	.8
Miranda-Williams complex, nearly level	10	12	8	10	21	26	.8
Mondamin silty clay loam, gently sloping	18	23	12	15	30	37	1.0
Oahe loam, nearly level	18	23	9	12	22	27	1.1
Oahe loam, undulating	15	19	8	10	20	25	1.0
Oahe-Sioux loams, nearly level	17	21	8	10	21	26	1.0
Oahe-Sioux loams, undulating	13	16	7	9	20	25	.9
Orman silty clay, nearly level	15	19	13	16	25	31	1.3
Orman silty clay, gently sloping	13	16	11	14	22	27	1.0
Promise silty clay, gently sloping	13	16	11	14	22	27	1.0
Promise silty clay, sloping	10	12	9	11	13	16	.8
Raber loam, nearly level	19	24	12	15	29	36	1.3
Raber loam, undulating	17	21	10	13	25	31	1.0
Raber loam, rolling	9	11	6	8	14	17	.9
Raber-Cavour loams, nearly level	15	19	12	15	25	31	1.2
Raber-Cavour loams, undulating	13	16	10	13	22	27	1.0
Raber-Eakin complex, nearly level	21	26	13	16	30	37	1.3
Raber-Eakin complex, undulating	18	23	11	14	27	34	1.1
Raber-Eakin complex, rolling	9	11	9	11	14	17	.9
Raber-Miranda complex, nearly level	14	17	10	12	24	30	1.1
Raber-Miranda complex, undulating	13	16	9	11	21	26	.9
Raber-Zahl complex, rolling	8	10	6	8	14	17	.9
Raber-Zahl loams, rolling	8	10	6	8	14	17	.9
Sioux loam	10	12	7	9	19	24	.9
Sioux-Oahe loams	11	14	7	9	20	25	.9
Sioux-Wessington loams	13	16	7	9	21	26	1.0
Spottswood loam, nearly level	23	29	10	13	24	30	1.3
Spottswood complex, nearly level	10	12	7	9	20	25	1.0
Tetonka silt loam, somewhat poorly drained	23	29	13	16	32	40	1.5
Wessington loam, nearly level	20	25	10	13	24	30	1.2
Wessington loam, undulating	17	21	9	11	21	26	1.1
Wessington-Sioux loams, nearly level	19	24	9	11	22	27	1.1
Wessington-Sioux loams, undulating	14	17	7	9	21	26	1.0
Williams loam, undulating	17	21	10	13	26	32	1.1
Williams loam, rolling	9	11	6	8	14	17	.9
Williams-Bonilla loams, nearly level	21	26	14	17	31	38	1.4
Williams-Bonilla loams, undulating	19	24	11	14	27	34	1.2
Williams-Cavour loams, nearly level	15	19	12	15	26	32	1.2
Williams-Cavour loams, undulating	13	16	10	13	24	30	1.0
Williams-Eakin complex, undulating	19	24	11	14	27	34	1.2
Williams-Miranda complex, nearly level	15	19	10	12	26	32	1.1
Williams-Miranda complex, undulating	13	16	9	11	22	27	.9
Williams-Sioux complex, undulating	15	19	10	13	25	31	1.0
Williams-Sioux complex, rolling	8	10	6	8	14	17	.9
Williams-Zahl complex, rolling	8	10	6	8	14	17	.9
Williams-Zahl loams, rolling	8	10	6	8	14	17	.9

of native vegetation have also lowered the amount of forage produced.

Four range condition classes have been defined to show the present condition of the natural vegetation on a range site in relation to the native vegetation that could grow there.

A range is in excellent condition if 75 to 100 percent of the cover consists of the native vegetation. It is in good condition if the percentage is between 50 and 75 percent; in fair condition if the percentage is between 25 and 50 percent; and in poor condition if the percentage is less than 25.

In Hand County, many areas used for grazing were once cultivated. These are called "go-back" fields. Because cultivation has resulted in erosion, the "go-back" fields may not fit into the same range sites they were in before being farmed. The loss of fertile surface soil reduces the amount of vegetation that can be produced in these areas. Consequently, grazing must be regulated so that vegetation can become established and protect the soil from further erosion. Where erosion has been slight, suitable native grasses can be seeded, and the fields, if not overgrazed, will become productive in a few years.

In many areas, fences are removed and the "go-back" fields are included in an area of native pasture. Cattle then concentrate in the "go-back" field, where there is less dead grass from the previous year's growth. As a result, the succulent small plants are overgrazed, while the adjacent native pasture is not used enough. Although cattle graze the "go-back" fields intensely, the amount of beef produced will be lower in following years than if these fields are kept fenced until vigorous plants are established.

Range sites of Hand County

The soils of Hand County have been grouped into range sites that are described in the following pages. The description of each range site lists the soils of the site, tells something about their characteristics, and points out the principal grasses. Suggested stocking rates, or numbers of livestock that can be grazed, are given for some of the range sites. These stocking rates are estimates based on the kind of soils the site contains and the condition of the site as determined by the kind of grasses present. The suggested stocking rates apply only during periods when precipitation is normal. The stocking system should be flexible so that the number of livestock can be increased when precipitation is above normal and can be reduced when precipitation is below normal.

SUBIRRIGATED RANGE SITE

This range site is made up of a dark-colored soil that is in low-lying positions. During part of the year, the water table is in the subsoil, but water rarely covers the surface of the soil. The only soil in this site is--

Lamoure silty clay loam, nearly level.

In excellent condition this site has a stand of mainly prairie cordgrass, big bluestem, switchgrass, and slender wheatgrass. When the site is overgrazed, western wheatgrass and Kentucky bluegrass tend to increase, but they decrease if overgrazing continues. In places where grazing is not limited, inland saltgrass and weeds become established and forage production is low.

If properly grazed, the Subirrigated site produces more forage than the Silty and Clayey sites of the uplands. If in excellent condition, it will produce about twice as much forage as these sites.

OVERFLOW RANGE SITE

The soils of this site are in depressions, below steep areas, and along streams that overflow regularly. They receive additional moisture as runoff from adjacent slopes or as floodwater from the streams. The soils of this site are--

Harriet-LaDelle silty clay loams, nearly level.

Harriet-Lane silty clay loams, nearly level.

McKenzie clay, level.

Tetonka silt loam, somewhat poorly drained.

Tetonka silt loam, poorly drained.

In excellent condition this site has a cover of switchgrass, big bluestem, prairie cordgrass, and Canada wildrye. When it is overgrazed, these grasses decrease while western wheatgrass increases. Kentucky bluegrass and weeds become established in areas where grazing has not been curtailed.

Because of past management practices, the areas of this site have different kinds of forage. Consequently, no stocking rates are given. Small areas of this site are included with larger tracts of different sites. They are managed in the same way as the larger tracts, and in dry seasons, when they furnish the only green vegetation on the range, they are frequently overgrazed. For stocking rates on large tracts of the Overflow range site, consult a representative of the local soil and water conservation district or the county extension agent.

OVERFLOW DENSE CLAY RANGE SITE

The soil of this site is in shallow depressions that are flooded for short periods each year. Most areas have natural outlets, and the ponds do not become very deep. The soil has a very compact layer within 1 to 5 inches of the surface. This site consists of--

Hoven silty clay loam.

In excellent condition this site has a thick stand of western wheatgrass. In areas that have been overgrazed, this grass is less abundant and there is bare ground between the individual plants. In poor condition the site is nearly bare but has a scattering of western wheatgrass and small annual weeds.

Many areas of this site are small depressions that cannot be managed as separate tracts. These small depressions are moist, and they produce succulent western wheatgrass. As a result, they are frequently overgrazed in midsummer when the adjacent range no longer has green vegetation. Large areas of this site should be excluded from the adjacent range. Grazing then can be controlled, and the condition of the site can be maintained or

improved. If this site is grazed when wet, the vegetation will be trampled.

The stocking rate of this site depends on the condition of the range. When the range is in excellent condition, 0.85 animal-unit month[5] of grazing per acre is possible. Thus, 5 ot 6 acres are needed per cow for a 5-month grazing period. If the range is in good condition, 7 or 8 acres are needed; if it is in fair condition, 12 to 15 acres are needed. If it is in poor condition, the site should not be stocked and should not be grazed for 2 or 3 years.

SALINE LOWLAND RANGE SITE

This site is made up of wet areas that seldom have water on the surface. The surface soil is dark colored, contains some salt, and generally has much lime. This site consists of--

Saline alluvial land.

When in excellent condition, this site produces various amounts of Nuttall alkaligrass and alkali cordgrass. These grasses are replaced by saltgrass in areas that are overgrazed.

In excellent condition the Saline Lowland site is slightly more productive than the Silty and Clayey sites. Vegetation remains green longer on the Saline Lowland than on sites in the upland, and, consequently, cattle overgraze this site in midsummer. Overgrazing reduces yields of forage, but most areas are too small to be managed as separate tracts.

SANDY RANGE SITE

This range site consists of a well-drained sandy soil on nearly level to rolling topography. The soil has a surface layer of sandy loam, loamy fine sand, or loamy very fine sand texture. It has a low water-holding capacity, is very permeable, and has little runoff. It is very susceptible to wind erosion if the cover of plants is destroyed by excessive grazing. The only soil in this site is--

Maddock sandy loam.

When this site is in excellent condition, little bluestem and prairie sandreed are the main grasses. Blue grama, needle-and-thread, western wheatgrass, and sedges are the main plants in areas that have been overgrazed. Sand dropseed and red three-awn are common in some areas in poor condition.

Stocking rates of this site are similar to those of the Silty and Clayey sites. Warm-season grasses are more common on this site, and, as a result, when in excellent condition, it has a different grazing season than the Silty and Clayey sites. The stocking rates should be controlled rigidly so that the more productive plants are not replaced by short grasses and weeds.

SILTY RANGE SITE

This range site consists of well-drained soils in nearly level to rolling uplands and on nearly level terraces, or benches, along streams. The soils are deep, have a friable surface layer, and generally have a moderately permeable subsoil. The texture of the surface layer is loam or silt loam. Most of the cultivated acreage in the county would belong to this site if it were used as rangeland. The soils in this site are--

Agar association.
Bonilla-Cresbard loams, nearly level.
Bonilla-Houdek loams, nearly level.
Cavour complex, nearly level.
Cavour-Cresbard silt loams, nearly level.
Cavour-Eakin complex, nearly level.
Cavour-Houdek loams, nearly level.
Cavour-Houdek loams, undulating.
Cavour-Raber silt loams, nearly level.
Cavour-Williams loams, nearly level.
Cresbard-Bonilla loams, nearly level.
Cresbard-Cavour silt loams, nearly level.
Eakin association, nearly level.
Eakin association, undulating.
Eakin-Cavour complex, nearly level.
Eakin-Cavour complex, undulating.
Eakin-Miranda complex, nearly level.
Eakin-Miranda complex, undulating.
Eakin-Raber complex, nearly level.
Eakin-Raber complex, undulating.
Gann silt loam, nearly level.
Gann silt loam, gently sloping.
Hamerly loam, nearly level.
Hand loam, nearly level.
Hand loam, undulating.
Houdek loam, nearly level.
Houdek loam, undulating.
Houdek loam, rolling.
Houdek-Bonilla loams, nearly level.
Houdek-Bonilla loams, undulating.
Houdek-Cavour loams, nearly level.
Houdek-Cavour loams, undulating.
Houdek-Miranda complex, nearly level.
Houdek-Miranda complex, undulating.
LaDelle loam, nearly level.
LaDelle silt loam, nearly level.
LaDelle-Lamoure silt loams, nearly level.
Lane loam, gently sloping.
Oahe loam, nearly level.
Oahe loam, undulating.
Raber loam, nearly level.
Raber loam, undulating.
Raber loam, rolling.
Raber-Cavour loams, nearly level.
Raber-Cavour loams, undulating.
Raber-Eakin complex, nearly level.
Raber-Eakin complex, undulating.
Raber-Eakin complex, rolling.
Raber-Miranda complex, nearly level.
Raber-Miranda complex, undulating.
Spottswood complex, nearly level.
Spottswood loam, nearly level.
Wessington loam, nearly level.
Wessington loam, undulating.
Williams loam, undulating.
Williams loam, rolling.
Williams-Bonilla loams, nearly level.
Williams-Bonilla loams, undulating.
Williams-Cavour loams, nearly level.
Williams-Cavour loams, undulating.
Williams-Eakin complex, undulating.

[5] The term "animal-unit month" refers to the amount of forage or feed required to maintain one animal for a period of 30 days.

Williams-Miranda complex, nearly level.
Williams-Miranda complex, undulating.

This site, when in excellent condition, has a stand consisting mainly of green needlegrass, western wheatgrass, needle-and-thread, and blue grama and lesser amounts of little bluestem and side-oats grama. When in good or fair condition, it has a stand of mainly blue grama, western wheatgrass, Kentucky bluegrass, and needle-and-thread.

The stocking rate of this site depends on the condition of the range. When the range is in excellent condition, 0.65 animal-unit month of grazing per acre is possible. Thus, for a grazing period of 5 months, 7 to 9 acres are needed for a cow. If the range is in good condition, 10 to 12 acres are needed; if it is in fair condition, 15 to 17 acres are needed; and if it is in poor condition, at least 33 acres are needed.

SILTY-SHALLOW COMPLEX RANGE SITE

Soil mapping units in this range site are complexes of two or more soils. The main soils are given in the name of the each mapping unit. The range site is a complex of small areas that are principally silty soils and secondarily shallow soils. The shallow soils are in steep, rolling areas or in nearly level to hilly areas that are underlain by gravel at a slight depth. The soils in this site are--

Houdek-Sioux complex, undulating.
Houdek-Sioux complex, rolling.
Houdek-Sioux complex, hilly.
Houdek-Zahl complex, rolling.
Houdek-Zahl loams, rolling.
Oahe-Sioux loams, nearly level.
Oahe-Sioux loams, undulating.
Raber-Zahl complex, rolling.
Raber-Zahl loams, rolling.
Wessington-Sioux loams, nearly level.
Wessington-Sioux loams, undulating.
Williams-Sioux complex, undulating.
Williams-Sioux complex, rolling.
Williams-Sioux complex, hilly.
Williams-Zahl complex, rolling.
Williams-Zahl loams, rolling.

This site, because it includes the Shallow site, is slightly less productive than the Silty site that was previously described. The stocking rate should be decreased in those areas that contain a large proportion of soils of the Shallow site.

CLAYEY RANGE SITE

This range site consists of well-drained soils in nearly level to rolling uplands and on nearly level terraces, or benches, along streams. The topography is similar to that of the Silty range site. The soils of the Clayey site are deep, moderately fine and fine textured, and generally less permeable than the soils of the Silty site. The soils of the Clayey site are--

LaDelle silty clay loam, nearly level.
LaDelle silty clay loam, fans, nearly level.
LaDelle-Aberdeen silty clay loams, nearly level.
Lane silty clay, nearly level.
Lane-Exline silty clay loams, nearly level.
Lane-Exline silty clays, level.
Lane-Harriet silty clay loams, nearly level.
Mondamin silty clay loam, gently sloping.
Orman silty clay, nearly level.
Orman silty clay, gently sloping.
Promise silty clay, gently sloping.
Promise silty clay, sloping.
Promise silty clay, moderately steep.

When this site is in excellent condition, green needlegrass and western wheatgrass are the most common plants. These grasses have been replaced by blue grama, Kentucky bluegrass, and buffalograss in areas that have been overgrazed for a number of years.

The stocking rates for this site are similar to those given for the Silty site.

SHALLOW RANGE SITE

This range site is made up of shallow soils that occur on steep slopes or in areas where gravel is at a depth of 10 to 20 inches. Much of the precipitation runs off the steep slopes. The soils with gravelly subsoil have low water-holding capacity. This range site consists of--

Hilly gravelly land.
Lismas-Promise silty clays, hilly.
Rolling sandy land.
Rough broken land.
Sioux loam.
Zahl and Sioux soils, hilly.
Zahl and Sioux soils, steep.

When this site is in excellent condition, little bluestem and side-oats grama are the main forage plants. If the site is overgrazed, little bluestem decreases and side-oats grama becomes more abundant. These grasses are gradually replaced by weedy annuals when excessive grazing is continued for many years. The soils may be damaged by wind or water erosion if protective vegetation is destroyed by overgrazing.

The stocking rate depends on the condition of the range. When range that consists mainly of the Shallow site is in excellent condition, 10 to 12 acres are needed per cow for a grazing period of 5 months. From 13 to 15 acres are needed if the range is in good condition; from 18 to 22 acres, if it is in fair condition; and from 35 to 40 or more acres, if it is in poor condition.

SHALLOW-SILTY COMPLEX RANGE SITE

Soil mapping units in this range site are complexes of two or more soils. The main soils are given in the name of each mapping unit. The range site is a complex of small areas that are principally shallow soils and secondarily silty soils. The shallow soils, except in complexes with Sioux soils, are steep or hilly. The soils of this site are--

Sioux-Oahe loams.
Sioux-Wessington loams.
Zahl-Houdek complex, hilly.
Zahl-Houdek loams, hilly.
Zahl-Houdek loams, steep.
Zahl-Raber complex, hilly.
Zahl-Raber complex, steep.
Zahl-Raber loams, hilly.
Zahl-Raber loams, steep.
Zahl-Williams complex, hilly.

Zahl-Williams complex, steep.
Zahl-Williams loams, hilly.
Zahl-Williams loams, steep.

Because it includes silty areas, this complex range site is slightly more productive than the Shallow site. Consequently, it has a slightly higher stocking rate.

PANSPOTS RANGE SITE

In 20 to 50 percent of this range site, the soils have a claypan at or near the surface. Many areas have an uneven surface with many small depressions that are a few feet wide and a few inches deep. In these places the claypan is at the surface and the vegetation is sparse. The vegetation is thick, however, in the intervening areas where the claypan is absent or is a few inches below the surface. The soils of this range site are--

Exline complex, nearly level.
Exline silty clay, level.
Exline-Lane silty clay loams, nearly level.
Exline-Lane silty clays, level.
Harriet complex, nearly level.
Hurley-Orman silty clays, nearly level.
Miranda complex, nearly level.
Miranda-Eakin complex, nearly level.
Miranda-Houdek complex, nearly level.
Miranda-Houdek complex, undulating.
Miranda-Raber complex, nearly level.
Miranda-Raber complex, undulating.
Miranda-Williams complex, nearly level.

When this site is in excellent condition, the shallow depressions have a thin stand of western wheatgrass and blue grama and the more productive areas, between the depressions, have a cover similar to that of the Silty or Clayey sites. Saltgrass and broom snakeweed are common in overgrazed areas. Wind erosion occurs in the shallow depressions if the site is in fair or poor condition.

The stocking rate of this site depends on the condition of the range. When the range is in excellent condition, 12 to 15 acres are needed per cow for a grazing period of 5 months. If the range is in good condition, 15 to 20 acres are needed; if it is in fair condition, 20 to 25 acres are needed; and if it is in poor condition, at least 30 acres are needed.

Engineering Applications[6]

Since the end of the Second World War, engineers have become increasingly interested in soil survey maps. Among the major reasons for this interest are the publication of modern, accurate agricultural soil maps and the increase in highway construction and other engineering projects.

Soil testing for engineering purposes is painstaking and laborious. Engineers constantly seek more efficient means of obtaining better soil data. As the coverage of soil survey maps increases each year and the accuracy and reliability of the maps improve, engineers find more ways of using the maps to reduce the time and expense required for detailed engineering studies of the soils.

The estimated engineering properties and characteristics of the soils of Hand County presented in this section are based on a limited number of samples that have been tested by various agencies. Because the sampling and testing data are necessarily limited and because soils are not homogeneous, soil surveys of this type provide only general information. It is not intended that the data in this section will eliminate completely the need for sampling and testing soils for the design and construction of specific engineering projects. The information, however, can be used to--

1. Plan detailed soil investigations that may reduce the amount of sampling and testing required for a given project.
2. Make soil and land use studies that will aid in selecting and developing industrial, business, residential, and recreational sites.
3. Make preliminary estimates of the engineering properties of soils in the planning of agricultural drainage systems, farm ponds, irrigation systems, and diversion terraces.
4. Make preliminary evaluations of soil and ground conditions that will aid in selecting highway, airport, and public utility locations.
5. Locate areas where construction materials, such as gravel, sand, and clay, are most likely to be available.
6. Correlate performance of engineering structures with soil mapping units and thus develop information that will be useful in designing and maintaining the structures.
7. Determine the suitability of soil mapping units for cross-country movement of vehicles and construction equipment.
8. Develop other preliminary estimates for construction purposes pertinent to the particular area.

Some engineering terms, particularly those that apply to information presented in tabular form, are described within this section of the report. Others are included in the Glossary at the back of the report.

Discussion of the tables

Tables in this part of the report present test data, correlate these data with the mapping units shown on the soil map, and interpret the data in a form that is accessible to the engineer. Most of the soil tests were made according to procedures that conform to the requirements of the American Association of State Highway Officials (AASHO) (1). In this system, soil materials are classified in seven principal groups. The groups range from A-1, consisting of gravelly soils of

[6] This section was prepared under the guidance of the South Dakota Soil Engineering Interpretations Committee, consisting of representatives of the South Dakota Department of Highways, Soil Conservation Service, Bureau of Public Roads, and South Dakota State College. The assistance given by personnel of the South Dakota Department of Highways was performed under a cooperative agreement with the U.S. Department of Commerce, Bureau of Public Roads.

high bearing capacity, to A-7, consisting of clay soils having low strength when wet.

Some engineers prefer the Unified soil classification system (9). In this system, soil materials are identified as coarse grained (8 classes), fine grained (6 classes), or highly organic.

Most areas delineated on the soil map cannot be interpreted directly for engineering purposes, because they contain several intermingled soils that could not be mapped separately. The major, minor, and other soils in each mapping unit are listed in table 8. For large projects, such as highways that cross an area shown on the map, one can assume that 60 percent of the area is made up of the major soil, and 40 percent, of the minor soil. For a building site, however, these percentages would not be applicable, and a detailed inspection of the site would be needed. Consequently, the soil map and the information in table 8 serve only as a guide to the soils that may occur in any small part of a mapped area.

Brief descriptions of the soils of the county and estimates of their physical properties are given in table 9. Where test data were available, the estimates shown are based on test data obtained for the modal profiles. Where tests were not performed, the estimates shown are based on test data obtained from similar soils in the county or on test data obtained for these soils from other counties and on past experience in engineering construction. Since the estimates are only for the modal soils, considerable variation from these values should be anticipated. More information on the range of properties of the soils can be obtained in other sections of the report.

The high water table, as shown in table 9, varies from season to season and year to year for any specified soil. The information given for each soil applies to periods when the weather is normal.

The hydrologic soil group for each soil is shown in table 9. These groups indicate the runoff-producing potential of the soils. The groupings were made by estimating or observing intake of water at the end of a long storm on soils that were wet when the storm started, had swollen after wetting, and were bare of vegetation. The hydrologic soil groupings are defined as follows: A, Soils having high infiltration rates even when saturated; they consist chiefly of deep, well-drained to excessively drained sand or gravel, or both; these soils have a high rate of water transmission and a low runoff potential. B, Soils having moderate infiltration rates when saturated; they are chiefly moderately deep to deep, moderately well drained to well drained soils with moderately fine to moderately coarse texture; these soils have a moderate rate of water transmission. C, Soils having slow infiltration rates when saturated; they are chiefly (1) soils with a layer that impedes the downward movement of water, or (2) soils with moderately fine to fine texture and a slow infiltration rate. These soils have a slow rate of water transmission. D, Soils having very slow infiltration rates when saturated; they are chiefly (1) clay soils with a high swelling potential; (2) soils with a high permanent water table; (3) soils with a claypan or a clay layer at or near the surface; and (4) shallow soils over nearly impervious materials. These soils have a very slow rate of water transmission.

The normal depth to bedrock in the soils of each series is frequently of interest to the engineer. In this soil survey the soils were studied to a maximum depth of only 5 feet. In most parts of the county, however, the depth to bedrock exceeds 5 feet. Only the Promise and Lismas soils normally have bedrock (Pierre shale) within 5 feet of the surface.

Salt content ratings are relative estimates made from field examinations of the soils.

Permeability ratings, as shown in table 9, are for saturated soils. This data was obtained from the technical guide for South Dakota.

Available water-holding capacity is the amount of water held by the soil for use by plants after the free water has drained out.

Shrink-swell potential is an estimate of the swelling and shrinking of the soil. It is expressed in the following terms, which are based on the values for the liquid limit and the plasticity index (see tables 11 and 12) of the soil:

Shrink-swell potential:	Liquid limit	Plasticity index
Low	30 or less	10 or less.
Moderate	31 to 40	11 to 20.
High	41 to 60	21 to 40.
Very high	More than 60	More than 40.

A dual shrink-swell potential (for example, low to moderate) is assigned when the liquid limit indicates one shrink-swell potential rating but the plasticity index indicates another rating.

Soils that have a high shrink-swell potential change considerably in volume during the wetting or drying process. Buildings on shallow foundations in soils with a high shrink-swell potential will shift and their foundations may crack. Highways on such soils may show roughness and instability unless special precautions are taken.

In table 10 suitability ratings of the soils for various engineering uses are given. Also listed are soil features that affect the construction and maintenance of irrigation systems, terraces, and waterways. The interpretations in table 10 are based on the brief descriptions of the soils and their estimated properties in table 9 and on the engineering test data in tables 11 and 12.

The data for road subgrade, as given in table 10, are estimates of the suitability of soil material for the support of a roadway. If other factors remain constant, the soils that are more highly rated will be suitable for thinner, less costly pavement. The rating is based on texture. Plastic clay layers impede internal drainage and have low stability when wet, and soils that contain them generally are rated "poor."

The suitability for road fill is an evaluation of the soil material for use in constructing fills, mainly for highways. This estimate is based on soil data in tables 11 and 12 and on the assumption

TABLE 8.--Soils in each mapping unit

[Dashes indicate none or not significant]

Map symbol	Mapping unit	Major soil	Minor soil	Other soils
Ag	Agar association	Agar	Eakin	Raber.
BcA	Bonilla-Cresbard loams, nearly level	Bonilla	Cresbard	Cavour, Houdek, Tetonka.
BhA	Bonilla-Houdek loams, nearly level	Bonilla	Houdek	Cresbard, Cavour, Tetonka.
CaA	Cavour complex, nearly level	Cavour	----	Cresbard, Miranda.
CcA	Cavour-Cresbard silt loams, nearly level	Cavour	Cresbard	A soil like the Gann.
CeA	Cavour-Eakin complex, nearly level	Cavour	Eakin	Raber, Miranda, Cresbard.
ChA	Cavour-Houdek loams, nearly level	Cavour	Houdek	Bonilla, Cresbard, Tetonka.
ChB	Cavour-Houdek loams, undulating	Cavour	Houdek	Bonilla, Cresbard, Tetonka.
CmA	Cavour-Raber silt loams, nearly level	Cavour	Raber	Miranda, Eakin, Cresbard.
CnA	Cavour-Williams loams, nearly level	Cavour	Williams	Bonilla, Cresbard, Tetonka.
CrA	Cresbard-Bonilla loams, nearly level	Cresbard	Bonilla	Cavour.
CsA	Cresbard-Cavour silt loams, nearly level	Cresbard	Cavour	----
EaA	Eakin association, nearly level	Eakin	----	Agar, Raber, Cresbard.
EaB	Eakin association, undulating	Eakin	Agar	----
EcA	Eakin-Cavour complex, nearly level	Eakin	Cavour	Raber, Miranda, Agar.
EcB	Eakin-Cavour complex, undulating	Eakin	Cavour	Raber, Miranda, Agar.
EmA	Eakin-Miranda complex, nearly level	Eakin	Miranda	Raber, Cavour, Cresbard.
EmB	Eakin-Miranda complex, undulating	Eakin	Miranda	Raber, Cavour, Cresbard.
ErA	Eakin-Raber complex, nearly level	Eakin	Raber	Agar, Cresbard.
ErB	Eakin-Raber complex, undulating	Eakin	Raber	Agar, Cresbard.
EsA	Exline silty clay, level	Exline silty clay.	----	Lane silty clay.
EtA	Exline complex, nearly level	Exline silty clay loam.	LaDelle	Aberdeen, Lamoure, and a saline soil.
EvA	Exline-Lane silty clay loams, nearly level	Exline silty clay loam.	Lane silty clay loam.	----
ExA	Exline-Lane silty clays, level	Exline silty clay.	Lane silty clay.	----
GaA	Gann silt loam, nearly level	Gann	----	----
GaB	Gann silt loam, gently sloping	Gann	----	----
HaA	Hamerly loam, nearly level	Hamerly	----	----
HbA	Hand loam, nearly level	Hand	----	----
HbB	Hand loam, undulating	Hand	----	----
HcA	Harriet complex, nearly level	Harriet	Lane silty clay loam.	----
HdA	Harriet-LaDelle silty clay loams, nearly level.	Harriet	LaDelle silty clay loam.	----
HeA	Harriet-Lane silty clay loams, nearly level	Harriet	Lane silty clay loam.	----
Hg	Hilly gravelly land	(1/)	(1/)	(1/)
HhA	Houdek loam, nearly level	Houdek	----	Bonilla.
HhB	Houdek loam, undulating	Houdek	----	Bonilla.
HhC	Houdek loam, rolling	Houdek	----	Bonilla, Zahl.

TABLE 8.--Soils in each mapping unit--Continued

[Dashes indicate none or not significant]

Map symbol	Mapping unit	Major soil	Minor soil	Other soils
HkA	Houdek-Bonilla loams, nearly level	Houdek	Bonilla	Cresbard, Cavour, Tetonka.
HkB	Houdek-Bonilla loams, undulating	Houdek	Bonilla	Cresbard, Cavour, Tetonka.
HlA	Houdek-Cavour loams, nearly level	Houdek	Cavour	Bonilla, Cresbard, Miranda.
HlB	Houdek-Cavour loams, undulating	Houdek	Cavour	Bonilla, Cresbard, Miranda.
HmA	Houdek-Miranda complex, nearly level	Houdek	Miranda	Cavour, Cresbard, Bonilla.
HmB	Houdek-Miranda complex, undulating	Houdek	Miranda	Cavour, Cresbard, Bonilla.
HsB	Houdek-Sioux complex, undulating	Houdek	Sioux	Bonilla.
HsC	Houdek-Sioux complex, rolling	Houdek	Sioux	Bonilla, Zahl, Cresbard.
HsD	Houdek-Sioux complex, hilly	Houdek	Sioux	Bonilla, Zahl, Cresbard.
HtD	Houdek-Zahl complex, rolling	Houdek	Zahl gravelly loam.	Bonilla, Gann.
HuD	Houdek-Zahl loams, rolling	Houdek	Zahl loam	Bonilla, Gann.
Hv	Hoven silty clay loam	Hoven	----	----
HyA	Hurley-Orman silty clays, nearly level	Hurley	Orman	----
LaA	LaDelle loam, nearly level	LaDelle loam.	----	----
LbA	LaDelle silt loam, nearly level	LaDelle silt loam.	----	----
LcA	LaDelle silty clay loam, nearly level	LaDelle silty clay loam.	----	----
LdA	LaDelle silty clay loam, fans, nearly level	LaDelle silty clay loam.	----	----
LeA	LaDelle-Aberdeen silty clay loams, nearly level.	LaDelle silty clay loam.	Aberdeen	----
LlA	LaDelle-Lamoure silt loams, nearly level	LaDelle silt loam.	Lamoure silt loam.	----
LmA	Lamoure silty clay loam, nearly level	Lamoure silty clay loam.	----	----
LnB	Lane loam, gently sloping	Lane loam	----	----
LoA	Lane silty clay, nearly level	Lane silty clay.	----	----
LpA	Lane-Exline silty clay loams, nearly level	Lane silty clay loam.	Exline silty clay loam.	----
LrA	Lane-Exline silty clays, level	Lane silty clay.	Exline silty clay.	----
LsA	Lane-Harriet silty clay loams, nearly level	Lane silty clay loam.	Harriet silty clay loam.	----
LtD	Lismas-Promise silty clays, hilly	Lismas	Promise	Zahl, Raber, Gann.
Ma	Maddock sandy loam	Maddock	----	----
McA	McKenzie clay, level	McKenzie	----	----
MdA	Miranda complex, nearly level	Miranda	----	Cavour, Cresbard.
MeA	Miranda-Eakin complex, nearly level	Miranda	Eakin	----
MhA	Miranda-Houdek complex, nearly level	Miranda	Houdek	Cavour, Cresbard, Bonilla.
MhB	Miranda-Houdek complex, undulating	Miranda	Houdek	Cavour, Cresbard, Bonilla.

TABLE 8.--Soils in each mapping unit--Continued

[Dashes indicate none or not significant]

Map symbol	Mapping unit	Major soil	Minor soil	Other soils
MrA	Miranda-Raber complex, nearly level	Miranda	Raber	Cavour, Eakin, Cresbard.
MrB	Miranda-Raber complex, undulating	Miranda	Raber	Cavour, Eakin, Cresbard.
MwA	Miranda-Williams complex, nearly level	Miranda	Williams	Cavour, Bonilla, Cresbard.
MyB	Mondamin silty clay loam, gently sloping	Mondamin	---	---
OaA	Oahe loam, nearly level	Oahe	---	---
OaB	Oahe loam, undulating	Oahe	---	Some areas have a soil like the Exline.
OhA	Oahe-Sioux loams, nearly level	Oahe	Sioux	---
OhB	Oahe-Sioux loams, undulating	Oahe	Sioux	---
OrA	Orman silty clay, nearly level	Orman	---	Hurley.
OrB	Orman silty clay, gently sloping	Orman	---	Hurley.
PrB	Promise silty clay, gently sloping	Promise	---	Orman, Raber.
PrC	Promise silty clay, sloping	Promise	---	Raber, Zahl, Lismas.
PrD	Promise silty clay, moderately steep	Promise	---	Raber, Zahl, Lismas.
RaA	Raber loam, nearly level	Raber	---	---
RaB	Raber loam, undulating	Raber	---	---
RaC	Raber loam, rolling	Raber	---	Zahl.
RcA	Raber-Cavour loams, nearly level	Raber	Cavour	Miranda, Eakin, Cresbard.
RcB	Raber-Cavour loams, undulating	Raber	Cavour	Miranda, Eakin, Cresbard.
ReA	Raber-Eakin complex, nearly level	Raber	Eakin	Cresbard, Cavour.
ReB	Raber-Eakin complex, undulating	Raber	Eakin	Cresbard, Cavour.
ReC	Raber-Eakin complex, rolling	Raber	Eakin	Cresbard, Cavour.
RmA	Raber-Miranda complex, nearly level	Raber	Miranda	Cavour, Cresbard, Eakin.
RmB	Raber-Miranda complex, undulating	Raber	Miranda	Cavour, Cresbard, Eakin.
RpC	Raber-Zahl complex, rolling	Raber	Zahl gravelly loam.	Zahl loam, Eakin, Gann.
RrC	Raber-Zahl loams, rolling	Raber	Zahl loam.	Eakin, Gann.
Rs	Rolling sandy land	(1/)	(1/)	(1/)
Ru	Rough broken land	(1/)	(1/)	(1/)
Sa	Saline alluvial land	(1/)	(1/)	(1/)
Sm	Sioux loam	Sioux	---	---
So	Sioux-Oahe loams	Sioux	Oahe	---
Sw	Sioux-Wessington loams	Sioux	Wessington	---
SxA	Spottswood loam, nearly level	Spottswood	---	---
SyA	Spottswood complex, nearly level	Spottswood	Cavour or a soil like the Miranda.	---
Tp	Tetonka silt loam, poorly drained	Tetonka	---	---
Tw	Tetonka silt loam, somewhat poorly drained	Tetonka	---	---
WeA	Wessington loam, nearly level	Wessington	---	---
WeB	Wessington loam, undulating	Wessington	---	---
WgA	Wessington-Sioux loams, nearly level	Wessington	Sioux	---
WgB	Wessington-Sioux loams, undulating	Wessington	Sioux	---
WmB	Williams loam, undulating	Williams	---	Bonilla, Cresbard.
WmC	Williams loam, rolling	Williams	---	Bonilla, Cresbard.
WnA	Williams-Bonilla loams, nearly level	Williams	Bonilla	Cresbard.
WnB	Williams-Bonilla loams, undulating	Williams	Bonilla	Cresbard.

TABLE 8.--Soils in each mapping unit--Continued

[Dashes indicate none or not significant]

Map symbol	Mapping unit	Major soil	Minor soil	Other soils
WpA	Williams-Cavour loams, nearly level	Williams	Cavour	Cresbard, Bonilla, Miranda.
WpB	Williams-Cavour loams, undulating	Williams	Cavour	Cresbard, Bonilla, Miranda.
WrA	Williams-Eakin complex, undulating	Williams	Eakin	----------
WsA	Williams-Miranda complex, nearly level	Williams	Miranda	Cavour, Bonilla, Cresbard.
WsB	Williams-Miranda complex, undulating	Williams	Miranda	Cavour, Bonilla, Cresbard.
WuB	Williams-Sioux complex, undulating	Williams	Sioux	Bonilla.
WuC	Williams-Sioux complex, rolling	Williams	Sioux	Bonilla, Zahl.
WuD	Williams-Sioux complex, hilly	Williams	Sioux	Zahl, Bonilla.
WxC	Williams-Zahl complex, rolling	Williams	Zahl gravelly loam.	Bonilla.
WzC	Williams-Zahl loams, rolling	Williams	Zahl loam	Bonilla.
ZaD	Zahl-Houdek complex, hilly	Zahl gravelly loam.	Houdek	Bonilla, Cresbard, Tetonka.
ZhD	Zahl-Houdek loams, hilly	Zahl loam	Houdek	Bonilla, Cresbard, Tetonka.
ZhE	Zahl-Houdek loams, steep	Zahl loam	Houdek	Bonilla, Cresbard, Tetonka.
ZmD	Zahl-Raber complex, hilly	Zahl gravelly loam.	Raber	Gann, Eakin.
ZmE	Zahl-Raber complex, steep	Zahl gravelly loam.	Raber	Gann, Eakin.
ZrD	Zahl-Raber loams, hilly	Zahl loam	Raber	Gann, Eakin.
ZrE	Zahl-Raber loams, steep	Zahl loam	Raber	Gann, Eakin.
ZsD	Zahl and Sioux soils, hilly	Zahl	Sioux	Various soils.
ZsE	Zahl and Sioux soils, steep	Zahl	Sioux	Various soils.
ZxD	Zahl-Williams complex, hilly	Zahl gravelly loam.	Williams	Gann, Bonilla, and a soil like the Sioux.
ZxE	Zahl-Williams complex, steep	Zahl gravelly loam.	Williams	Gann, Bonilla,and a soil like the Sioux.
ZyD	Zahl-Williams loams, hilly	Zahl loam	Williams	Gann, Bonilla, and a soil like the Sioux.
ZyE	Zahl-Williams loams, steep	Zahl loam	Williams	Gann, Bonilla, and a soil like the Sioux.

1/ See description of mapping unit in the section "Descriptions of the Soils."

that the proper practices will be used in constructing the fill.

The suitability of soil material for road fill depends largely on its texture and water content. Highly plastic soil materials with a high natural water content are rated "poor." Highly erodible soils (silts and fine sands) are difficult to compact and require moderately gentle slopes and quick coverage by vegetation; therefore, they are rated "poor to fair."

The suitability for seeding and sodding is an estimate of the effect of texture, fertility, and other characteristics on the ability of the soil to support plants. Information in this column will be helpful to those who wish to grow vegetation for esthetic purposes, erosion control, or other purposes.

Susceptibility to frost action is determined by the physiographic position and the physical properties of the soil. The ratings used by the South

TABLE 9.--Brief descriptions and estimated

Soil	Range of slope	Soil description	High water table	Engineering classifications	
				Unified	AASHO
	Percent				
Aberdeen silty clay loam---	1 to 3--	Deep, somewhat poorly drained to moderately well drained soil in stream alluvium.	Occasionally in the profile.	CL-CH---	A-7-6, A-6-----
Agar silt loam----------	0 to 3--	Deep, well-drained soil formed from loess at least 30 inches thick over glacial till.	Usually below a depth of 5 feet.	ML------	A-4, A-6-------
Bonilla loam or silt loam--	0 to 3--	Deep, moderately well drained soil in upland drainageways or nearly level areas; formed from glacial till or local alluvium.	Usually below a depth of 5 feet.	CL------	A-6, A-7-6-----
Cavour loam or silt loam---	0 to 3--	Deep, moderately well drained to somewhat poorly drained soil in upland drainageways or nearly level areas; formed from glacial till, loess, and local alluvium.	Seasonally perched, usually below a depth of 5 feet.	ML-CL---	A-6, A-7-6-----
Cresbard silt loam or loam-	0 to 3--	Deep, moderately well drained soil formed from glacial till, loess, and alluvium.	Usually below a depth of 5 feet, but some low areas are ponded.	CL-CH---	A-7-6----------
Eakin silt loam----------	1 to 8--	Deep, well-drained soil in uplands; formed from loess less than 30 inches thick over glacial till.	Usually below a depth of 5 feet.	ML, Cl, CH.	A-6, A-7-6-----

physical properties of the soils

Hydrologic soil groups	Horizon	Depth	USDA texture	Salt content	Permeability	Available water holding capacity	Shrink-swell potential
		Inches			Inches per hour	Inches per inch of soil	
D------	A_1------	0 to 8---	Silty clay loam----	Low----------	0.20 to 0.80--	0.14 to 0.21--	Moderate.
	A_2------	8 to 12--	Silt loam----------	Low----------	0.20 to 0.80--	0.14 to 0.21--	Low.
	B_2------	12 to 28--	Silty clay to silty clay loam.	Low----------	0.20 to 0.80--	0.14 to 0.21--	High.
	C_{ca}-----	28 to 46--	Silty clay loam----	Medium----------	0.20 to 0.80--	0.14 to 0.21--	High.
	C-------	46 to 60--	Silt loam to silty clay loam.	Medium to high--	0.20 to 0.80--	0.14 to 0.21--	High.
B------	A_1------	0 to 5---	Silt loam to loam--	Low----------	0.80 to 2.50--	0.13 to 0.20--	Moderate.
	B-------	5 to 20--	Silty clay loam----	Low----------	0.20 to 0.80--	0.14 to 0.21--	Moderate.
	B_{3ca}----	20 to 30--	Silt loam----------	Low----------	0.80 to 2.50--	0.14 to 0.21--	Moderate.
	C_{ca}-----	30 to 42--	Silt loam----------	Low----------	0.80 to 2.50--	0.14 to 0.21--	Moderate.
	C-D-----	42 to 60--	Silt loam or clay loam.	Low----------	0.80 to 2.50--	0.14 to 0.21--	Moderate to high.
B------	A_1------	0 to 6---	Loam to silt loam--	Low----------	0.80 to 2.50--	0.13 to 0.20--	Moderate to high.
	A_3-B_1---	6 to 16--	Loam to silt loam--	Low----------	0.80 to 2.50--	0.13 to 0.20--	Moderate to high.
	B_2------	16 to 27--	Clay loam----------	Low----------	0.20 to 0.80--	0.14 to 0.21--	Moderate to high.
	B_{3ca}----	27 to 43--	Loam to clay loam--	Low to medium---	0.80 to 0.20--	0.13 to 0.20--	Moderate to high.
	C-------	43 to 60--	Loam to clay loam--	Low to medium---	0.80 to 0.20--	0.13 to 0.20--	Moderate to high.
D------	A_1------	0 to 5---	Loam to silt loam--	Low----------	0.80 to 2.50--	0.13 to 0.20--	Low to moderate.
	A_2------	5 to 9---	Loam to silt loam--	Low----------	0.20 to 0.80--	0.13 to 0.20--	Low.
	B_{22}-----	9 to 17--	Silty clay loam to silty clay.	Low to medium---	0.20 to 0.80--	0.14 to 0.21--	Moderate.
	B_{3ca}----	17 to 35--	Clay loam to loam--	Medium to high--	0.20 to 0.80--	0.14 to 0.21--	Moderate to high.
	C-------	35 to 60--	Clay loam to loam--	Medium to high--	0.20 to 0.80--	0.14 to 0.21--	Moderate to high.
C------	A_1------	0 to 8---	Silt loam to loam--	Low----------	0.80 to 2.50--	0.14 to 0.21--	Moderate.
	A_2------	8 to 10--	Silt loam to loam--	Low----------	0.20 to 0.80--	0.14 to 0.21--	Low.
	B_2------	10 to 23--	Clay loam to silty clay loam.	Low----------	0.20 to 0.80--	0.14 to 0.21--	Moderate to high.
	B_{3ca}----	23 to 45--	Clay loam to loam--	Low to medium---	0.20 to 0.80--	0.14 to 0.21--	Moderate to high.
	C-------	45 to 60--	Clay loam to loam--	Medium to high--	0.20 to 0.80--	0.14 to 0.21--	Moderate to high.
B------	A_1------	0 to 4---	Silt loam to loam--	Low----------	0.80 to 2.50--	0.14 to 0.21--	Low to high.
	B_2------	4 to 12--	Silty clay loam to silt loam.	Low----------	0.20 to 0.80--	0.14 to 0.21--	Moderate to high.
	B_{2ca}----	12 to 22--	Silt loam----------	Low----------	0.80 to 2.50--	0.14 to 0.21--	Moderate to high.
	B_{3ca}----	22 to 29--	Silt loam----------	Low----------	0.80 to 2.50--	0.14 to 0.21--	Moderate to high.
	D_{ca}-----	29 to 60--	Clay loam----------	Medium to high--	0.20 to 0.80--	0.14 to 0.21--	High to very high.

TABLE 9.--Brief descriptions and estimated

Soil	Range of slope	Soil description	High water table	Engineering classifications	
				Unified	AASHO
	Percent				
Exline silty clay----------	0 to 2--	Deep, moderately well drained to somewhat poorly drained soil in silty clay or silty clay loam alluvium.	May be perched, usually below a depth of 5 feet.	CH------	A-7-6----------
Gann silt loam------------	2 to 5--	Deep, moderately well drained to well drained soil in local alluvium.	Below a depth of 5 feet, but some areas accumulate runoff from higher slopes.	ML-CL---	A-7-6----------
Hammerly loam-------------	0 to 2--	Deep, somewhat poorly drained soil formed from glacial till.	Occasionally at surface.	CL------	A-6----------
Hand loam-----------------	1 to 3--	Deep, moderately well drained to well drained soil in glacial alluvium.	Below a depth of 5 feet.	CL------	A-6----------
Harriet silty clay loam----	0 to 2--	Deep, somewhat poorly to poorly drained soil in stream alluvium.	May be perched, but some areas are flooded.	CL, CH--	A-6, A-7-6-----
Houdek loam---------------	1 to 8--	Deep, well-drained soil formed from glacial till.	Below a depth of 5 feet.	CL------	A-6----------

physical properties of the soils--Continued

Hydrologic soil groups	Horizon	Depth	USDA texture	Salt content	Permeability	Available water holding capacity	Shrink-swell potential
		Inches			Inches per hour	Inches per inch of soil	
D------	A_1 to A_2.	0 to 1---	Silt loam to silty clay loam.	Low----------	0.20 to 0.80--	0.14 to 0.21--	Moderate.
	B_2------	1 to 15--	Silty clay---------	Low to medium---	0.00 to 0.20--	0.18 to 0.21--	High.
	B_{3ca}----	15 to 22--	Silty clay to silty clay loam.	Medium to high--	0.00 to 0.20--	0.14 to 0.21--	High.
	C-------	22 to 60--	Silty clay to silty clay loam.	Medium to high--	0.00 to 0.20--	0.14 to 0.21--	High.
B------	A_1------	0 to 6---	Silt loam to silty clay loam.	Low----------	0.80 to 2.50--	0.14 to 0.21--	Moderate to high.
	B_1------	6 to 20--	Silt loam to silty clay loam.	Low----------	0.80 to 2.50--	0.14 to 0.21--	Moderate to high.
	B_{2ca}----	20 to 30--	Silt loam to silty clay loam.	Low----------	0.80 to 2.50--	0.14 to 0.21--	Moderate to high.
	B_3------	30 to 50--	Silt loam to silty clay loam.	Low----------	0.80 to 2.50--	0.14 to 0.21--	Moderate to high.
	C-------	50 to 60--	Silt loam to silty clay loam.	Low to medium---	0.80 to 2.50--	0.14 to 0.21--	Moderate to high.
C------	A_1------	0 to 6---	Loam----------	Low----------	0.80 to 2.50--	0.13 to 0.20--	Moderate.
	B_{ca}-----	6 to 10--	Loam----------	Low----------	0.80 to 2.50--	0.13 to 0.20--	Moderate.
	C_{ca}-----	10 to 25--	Loam----------	Low to medium---	0.80 to 2.50--	0.13 to 0.20--	Moderate.
	C-------	25 to 60--	Loam----------	Low to medium---	0.80 to 2.50--	0.13 to 0.20--	Moderate.
B------	A_1------	0 to 6---	Loam----------	Low----------	0.80 to 2.50--	0.13 to 0.20--	Low.
	B_2------	6 to 26--	Loam----------	Low----------	0.80 to 2.50--	0.13 to 0.20--	Moderate.
	C_{ca}-----	26 to 41--	Loam----------	Low----------	0.80 to 2.50--	0.13 to 0.20--	Moderate.
	C-------	41 to 60--	Silt loam, loam, fine sandy loam.	Low----------	0.80 to 2.50--	0.13 to 0.20--	Moderate.
D------	A_1------	0 to 1---	Silt loam to silty clay loam.	Low----------	0.20 to 0.80--	0.14 to 0.21--	Moderate.
	B_2------	1 to 10--	Silt loam to silty clay loam.	Low to medium---	0.20 to 0.80--	0.14 to 0.21--	High.
	B_{3ca}----	10 to 17--	Silty clay loam---	Medium to high--	0.20 to 0.80--	0.14 to 0.21--	High.
	B_3------	17 to 40--	Silty clay to silty clay loam.	Medium to high--	0.00 to 0.20--	0.14 to 0.21--	High.
	B-C-----	40 to 56--	Silty clay to silty clay loam.	Medium to high--	0.00 to 0.20--	0.14 to 0.21--	High.
	C-------	56 to 60--	Silty clay to silty clay loam.	Medium to high--	0.00 to 0.20--	0.14 to 0.21--	High.
B------	A_1------	0 to 6---	Loam----------	Low----------	0.80 to 2.50--	0.13 to 0.20--	Low to high.
	B_2------	6 to 14--	Loam----------	Low----------	0.80 to 2.50--	0.13 to 0.20--	Moderate.
	B_3-C_{ca}--	14 to 35--	Loam to clay loam--	Low to medium---	0.20 to 0.80--	0.14 to 0.21--	Moderate to high.
	C-------	35 to 60--	Loam to clay loam--	Low to medium---	0.20 to 0.80--	0.14 to 0.21--	Moderate.

TABLE 9.--Brief descriptions and estimated

Soil	Range of slope	Soil description	High water table	Engineering classifications	
				Unified	AASHO
	Percent				
Hoven silty clay loam------	0-------	Deep, poorly drained soil in depressions; consists of alluvium.	Frequently above surface.	CL, CH--	A-6, A-7-6-----
Hurley silty clay----------	0 to 2--	Deep, somewhat poorly drained soil in alluvium.	Areas may be flooded by runoff.	CH------	A-7-6----------
LaDelle loam---------------	1 to 3--	Deep, well drained to moderately well drained soil in alluvium.	Below a depth of 5 feet, but some areas may be flooded occasionally.	CL------	A-4, A-6, A-7-6.
LaDelle silt loam----------	0 to 3--	Deep, moderately well drained soil in stream alluvium.	Below a depth of 5 feet, but some areas may be flooded occasionally.	CL------	A-4, A-6, A-7-6.
Lamoure silt loam----------	1 to 3--	Deep, poorly drained soil in low areas, consists of alluvium.	Frequently near surface.	CH-CL---	A-6, A-7-6-----
Lane loam------------------	2 to 4--	Deep, well-drained soil in colluvial-alluvial sediments.	Below a depth of 5 feet.	ML, CL--	A-6, A-7-5, A-7-6.
Lane silty clay loam-------	0 to 3--	Deep, moderately well drained soil in alluvium.	Below a depth of 5 feet, but some areas may be flooded frequently.	MH-CL---	A-6, A-7-5, A-7-6.
Lane silty clay------------	0 to 2--	Deep, moderately well drained to somewhat poorly drained soil in alluvium.	Some areas may be flooded occasionally.	CL, CH--	A-6, A-7-6-----

physical properties of the soils--Continued

Hydrologic soil groups	Horizon	Depth	USDA texture	Salt content	Permeability	Available water holding capacity	Shrink-swell potential
		Inches			Inches per hour	Inches per inch of soil	
D------	A_1-A_2---	0 to 3---	Silty clay loam----	Low----------	0.20 to 0.80--	0.14 to 0.21--	Moderate.
	B_2------	3 to 9---	Silty clay to silty clay loam.	Low----------	0.20 to 0.80--	0.14 to 0.21--	High.
	B_3------	9 to 18--	Silty clay to silty clay loam.	Low to medium---	0.20 to 0.80--	0.14 to 0.21--	High.
	C-------	18 to 60--	Silty clay to silty clay loam.	Low to medium---	0.20 to 0.80--	0.14 to 0.21--	High.
D------	A_1-A_2---	0 to 3---	Silty clay to silty clay loam.	Low----------	0.00 to 0.20--	0.18 to 0.21--	High.
	B_2------	3 to 14--	Silty clay---------	Low to medium---	0.00 to 0.20--	0.18 to 0.21--	High.
	B_{3ca}----	14 to 24--	Silty clay---------	Medium to high--	0.00 to 0.20--	0.18 to 0.21--	High.
	C-------	24 to 45--	Silty clay---------	Medium to high--	0.00 to 0.20--	0.18 to 0.21--	High.
	C-D-----	45 to 60--	Silty clay---------	Medium to high--	0.00 to 0.20--	0.18 to 0.21--	High.
B------	A_1------	0 to 5---	Loam---------------	Low----------	0.80 to 2.50--	0.13 to 0.20--	Moderate.
	A-B-----	5 to 10--	Loam---------------	Low----------	0.80 to 2.50--	0.13 to 0.20--	Moderate.
	B_2------	10 to 18--	Loam---------------	Low----------	0.80 to 2.50--	0.13 to 0.20--	Moderate.
	B_3------	18 to 24--	Loam---------------	Low----------	0.80 to 2.50--	0.13 to 0.20--	Moderate.
	C-------	24 to 60--	Loam to clay loam--	Low to medium---	0.80 to 2.50--	0.13 to 0.20--	Moderate.
B------	A_1------	0 to 7---	Silt loam----------	Low----------	0.80 to 2.50--	0.14 to 0.21--	Low to moderate.
	B_2------	7 to 23--	Silt loam----------	Low----------	0.80 to 2.50--	0.14 to 0.21--	Moderate.
	B_{3ca}----	23 to 31--	Silt loam----------	Low----------	0.80 to 2.50--	0.14 to 0.21--	Moderate.
	C-------	31 to 60--	Silt loam----------	Low to medium---	0.80 to 2.50--	0.14 to 0.21--	Low to moderate.
C------	A_1------	0 to 16--	Silty clay loam----	Low----------	0.20 to 0.80--	0.14 to 0.21--	Moderate to high.
	B-------	16 to 24--	Silty clay loam----	Low to medium---	0.20 to 0.80--	0.14 to 0.21--	Moderate to high.
	C-------	24 to 60--	Silty clay loam----	Low to high-----	0.20 to 0.80--	0.14 to 0.21--	Moderate to high.
B------	A_1------	0 to 6---	Loam---------------	Low----------	0.80 to 2.50--	0.13 to 0.20--	Low to moderate.
	B-------	6 to 20--	Loam to clay loam--	Low----------	0.20 to 0.80--	0.14 to 0.21--	Moderate.
	C-------	20 to 60--	Clay loam to loam--	Low to medium---	0.20 to 0.80--	0.14 to 0.21--	Moderate.
C------	A_1------	0 to 5---	Silty clay loam----	Low----------	0.20 to 0.80--	0.14 to 0.21--	High.
	B_2------	5 to 18--	Silty clay loam----	Low----------	0.20 to 0.80--	0.14 to 0.21--	High.
	B_3------	18 to 24--	Silty clay loam----	Low to medium---	0.20 to 0.80--	0.14 to 0.21--	High.
	C-------	24 to 60--	Silty clay loam----	Low to high-----	0.20 to 0.80--	0.14 to 0.21--	Moderate.
C------	A_1------	0 to 4---	Silty clay---------	Low----------	0.00 to 0.20--	0.18 to 0.21--	High.
	B_2------	4 to 26--	Silty clay---------	Low----------	0.00 to 0.20--	0.18 to 0.21--	High.
	B_3------	26 to 40--	Silty clay---------	Low to high-----	0.00 to 0.20--	0.18 to 0.21--	High.
	C-------	40 to 60--	Silty clay to gravel.	Low to high-----	0.00 to 0.20--	0.00 to 0.21--	High.

TABLE 9.--Brief descriptions and estimated

Soil	Range of slope	Soil description	High water table	Engineering classifications	
				Unified	AASHO
	Percent				
Limas silty clay----------	10 to 25-	Excessively drained soil on steep slopes; underlain by shale in the subsoil.	Below the profile.	CH------	A-7-5, A-7-6---
Maddock sandy loam---------	2 to 4--	Deep, well-drained soil formed from sand.	Below the profile.	SP-SM---	A-2, A-3-------
McKenzie clay-------------	0 to 1--	Deep, poorly drained soil in clay alluvium.	Perched when precipitation in heavy.	CH------	A-7-6----------
Miranda silt loam or loam--	0 to 3--	Deep, moderately well drained to somewhat poorly drained claypan soil formed from glacial till.	Perched when precipitation is heavy.	CL, CH--	A-6, A-7-6-----
Mondamin silty clay loam---	2 to 5--	Deep, well drained to moderately well drained soil in glacial alluvium.	Below a depth of 5 feet.	MH-CH---	A-7-6----------
Oahe loam-----------------	1 to 5--	Well-drained soil underlain by gravel at a depth of 20 to 36 inches.	Below a depth of 5 feet in most areas.	SM, SC, CL.	A-2, A-4, A-6--
Orman silty clay----------	1 to 5--	Deep, well drained to moderately well drained soil in silty clay alluvium.	Below a depth of 5 feet.	CH------	A-7-6----------
Promise silty clay---------	3 to 4--	Well-drained soil formed mainly from Pierre shale; underlain by bedrock of shale at a depth of about 30 inches.	Below a depth of 5 feet.	MH-CH---	A-7-5----------

physical properties of the soils--Continued

Hydrologic soil groups	Horizon	Depth	USDA texture	Salt content	Permeability	Available water holding capacity	Shrink-swell potential
		Inches			Inches per hour	Inches per inch of soil	
D------	A-------	0 to 2---	Silty clay---------	Low----------	0.00 to 0.20--	0.18 to 0.21--	High.
	B-------	2 to 13--	Silty clay---------	Low to medium---	0.00 to 0.20--	0.18 to 0.21--	High.
	D-------	13 to 60--	Clay---------------	Low to high-----	0.00 to 0.20--	0.18 to 0.21--	High.
A------	A_1------	0 to 10--	Sandy loam---------	Low----------	0.80 to 2.50--	0.11 to 0.17--	Low.
	C_1------	10 to 40--	Loamy sand---------	Low----------	2.50 to 5.00--	0.13 to 0.20--	Low.
	C_{ca}-----	40 to 60--	Loamy sand---------	Low----------	2.50 to 5.00--	0.13 to 0.20--	Low.
D------	A_1------	0 to 2---	Silty clay to clay-	Low to medium---	0.00 to 0.20--	0.18 to 0.21--	High.
	B_2------	2 to 25--	Clay---------------	Low to medium---	0.00 to 0.20--	0.18 to 0.21--	High.
	C-------	25 to 60--	Clay to silty clay-	Medium to high--	0.00 to 0.20--	0.18 to 0.21--	High.
D------	A_1------	0 to 3---	Silt loam to loam--	Low----------	0.20 to 0.80--	0.14 to 0.21--	Moderate.
	B_2------	3 to 7---	Silty clay loam----	Low----------	0.20 to 0.80--	0.14 to 0.21--	High.
	B_3------	7 to 15--	Silty clay loam----	Low to high-----	0.20 to 0.80--	0.14 to 0.21--	High.
	B_{3ca}----	15 to 27--	Silty clay loam to loam.	Medium to high--	0.20 to 0.80--	0.14 to 0.21--	High.
	C-------	27 to 60--	Clay loam to loam--	Medium to high--	0.20 to 0.80--	0.14 to 0.21--	High.
C------	A_1------	0 to 4---	Silty clay loam----	Low----------	0.20 to 0.80--	0.14 to 0.21--	Moderate to high.
	B_2------	4 to 15--	Silty clay loam----	Low----------	0.20 to 0.80--	0.14 to 0.21--	High.
	B_{3ca}----	15 to 35--	Silty clay loam----	Low----------	0.20 to 0.80--	0.14 to 0.21--	High.
	B_{3cs}----	35 to 54--	Silty clay loam----	Low----------	0.20 to 0.80--	0.14 to 0.21--	High.
	C-------	54 to 60--	Silty clay loam----	Low to medium---	0.20 to 0.80--	0.14 to 0.21--	High.
B------	A_1------	0 to 3---	Loam---------------	Low----------	0.80 to 2.50--	0.13 to 0.20--	Low.
	B_1------	3 to 5---	Loam---------------	Low----------	0.80 to 2.50--	0.13 to 0.20--	Low.
	B_2------	5 to 11--	Loam to sandy clay loam.	Low----------	0.80 to 2.50--	0.13 to 0.20--	Low.
	B_{3ca}----	11 to 24--	Loam to sandy clay loam.	Low----------	0.80 to 2.50--	0.13 to 0.20--	Low.
	D-------	24 to 60--	Sand to gravel-----	Low----------	2.50 to 5.00--	0.05 to 0.11--	Low.
D------	A_1------	0 to 4---	Silty clay---------	Low----------	0.00 to 0.20--	0.18 to 0.21--	High.
	B_2------	4 to 11--	Silty clay to clay-	Low----------	0.00 to 0.20--	0.18 to 0.21--	High.
	B_3------	11 to 18--	Silty clay to clay-	Low----------	0.00 to 0.20--	0.18 to 0.21--	High.
	C_{ca}-----	18 to 24--	Silty clay to clay-	Low to medium---	0.00 to 0.20--	0.18 to 0.21--	High.
	C-------	24 to 60--	Silty clay to clay-	Low to high-----	0.00 to 0.20--	0.18 to 0.21--	High.
D------	A_1------	0 to 3---	Clay---------------	Low----------	0.00 to 0.20--	0.18 to 0.21--	Moderate to very high.
	B_2------	3 to 28--	Clay---------------	Low----------	0.00 to 0.20--	0.18 to 0.21--	High to very high.
	D-B_3----	28 to 34--	Clay---------------	Low----------	0.00 to 0.20--	0.18 to 0.21--	High to very high.
	D-------	34 to 60--	Clay---------------	Medium to high--	0.00 to 0.20--	0.18 to 0.21--	High to very high.

TABLE 9.-- Brief descriptions and estimated

Soil	Range of slope	Soil description	High water table	Engineering classifications	
				Unified	AASHO
	Percent				
Raber loam----------	2 to 8--	Deep, well-drained soil formed from glacial till.	Below a depth of 5 feet.	CL, MH, CH.	A-7-5, A-7-6---
Sioux loam----------	1 to 5--	Excessively drained to well-drained soil underlain by gravel within 20 inches of the surface.	Below a depth of 5 feet in most areas.	GP-GM, ML.	A-1, A-2, A-4--
Spottswood loam----------	0 to 2--	Moderately well drained to somewhat poorly drained soil underlain by gravel within 20 to 36 inches of the surface.	May be at surface.	SM, ML--	A-2, A-4-------
Tetonka silt loam----------	0-------	Deep, poorly drained to somewhat poorly drained soil in depressions; consists of local alluvium.	Areas may be ponded.	ML-MH---	A-7-6----------
Wessington loam----------	1 to 4--	Well drained to moderately well drained soil underlain by gravel at a depth of 20 to 36 inches.	Below a depth of 5 feet in most areas.	ML------	A-7-5----------
Williams loam----------	1 to 8--	Deep, well-drained soil formed from glacial till.	Below a depth of 5 feet.	CL------	A-6, A-7-6-----
Zahl loam----------	9 to 35-	Excessively drained soil on steep slopes; formed from glacial till.	Below a depth of 5 feet.	CL------	A-6, A-7-6-----

physical properties of the soils--Continued

Hydrologic soil groups	Horizon	Depth	USDA texture	Salt content	Permeability	Available water holding capacity	Shrink-swell potential
		Inches			Inches per hour	Inches per inch of soil	
C------	A_1------	0 to 3---	Loam----------	Low----------	0.80 to 2.50--	0.13 to 0.20--	Low to high.
	B_2------	3 to 10--	Clay loam----------	Low----------	0.20 to 0.80--	0.14 to 0.21--	Moderate to high.
	B_{2ca}----	10 to 14--	Clay loam----------	Low----------	0.20 to 0.80--	0.14 to 0.21--	Moderate to high.
	B_{3ca}----	14 to 38--	Clay loam----------	Low----------	0.20 to 0.80--	0.14 to 0.21--	Moderate to high.
	C-------	38 to 60--	Clay loam----------	Low to medium---	0.20 to 0.80--	0.14 to 0.21--	High.
B------	A_1------	0 to 3---	Loam----------	Low----------	0.80 to 2.50--	0.13 to 0.20--	Low.
	B_2------	3 to 10--	Loam----------	Low----------	0.80 to 2.50--	0.13 to 0.20--	Low.
	B_3------	10 to 15--	Loam----------	Low----------	0.80 to 2.50--	0.13 to 0.20--	Low.
	D_{ca}-----	15 to 25--	Gravel----------	Low----------	2.50 to 5.00--	0.00 to 0.04--	Low.
	D-------	25 to 60--	----------	Low----------	2.50 to 5.00--	0.00 to 0.04--	Low.
B------	A_1------	0 to 12--	Loam----------	Low to medium---	0.80 to 2.50--	0.13 to 0.20--	Low.
	B_2------	12 to 26--	Loam----------	Low to medium---	0.80 to 2.50--	0.13 to 0.20--	Low.
	C_{ca}-----	26 to 34--	Sandy loam---------	Medium to high--	0.80 to 2.50--	0.11 to 0.17--	Low.
	D-------	34 to 60--	Gravel----------	Medium to high--	2.50 to 5.00--	0.00 to 0.04--	Low.
C------	A_1------	0 to 4---	Silt loam----------	Low----------	0.20 to 0.80--	0.14 to 0.21--	Moderate.
	A_2------	4 to 10--	Silt loam----------	Low----------	0.20 to 0.80--	0.14 to 0.21--	Low.
	B_2------	10 to 26--	Clay loam----------	Low----------	0.20 to 0.80--	0.14 to 0.21--	Moderate to high.
	B_3------	26 to 44--	Clay loam----------	Low----------	0.20 to 0.80--	0.14 to 0.21--	Moderate to high.
	C_{ca}-----	44 to 60--	Loam to clay loam--	Low to medium---	0.20 to 0.80--	0.14 to 0.21--	Moderate to high.
B------	A_1------	0 to 8---	Loam----------	Low----------	0.80 to 2.50--	0.13 to 0.20--	Low.
	B-------	8 to 24--	Loam----------	Low----------	0.80 to 2.50--	0.13 to 0.20--	Low.
	C_{ca}-----	24 to 30--	Loam----------	Low----------	0.80 to 2.50--	0.13 to 0.20--	Low.
	D-------	30 to 60--	Gravel----------	Low----------	2.50 to 5.00--	0.00 to 0.04--	Low.
B------	A_1------	0 to 4---	Loam----------	Low----------	0.80 to 2.50--	0.13 to 0.20--	Moderate.
	B_2------	4 to 13--	Clay loam----------	Low----------	0.20 to 0.80--	0.14 to 0.21--	High to moderate.
	B_{3ca}----	13 to 21--	Clay loam----------	Low----------	0.20 to 0.80--	0.14 to 0.21--	High.
	C_{ca}-----	21 to 46--	Loam to clay loam--	Low----------	0.80 to 2.50--	0.13 to 0.20--	High to moderate.
	C-------	46 to 60--	Loam to clay loam--	Low to medium---	0.80 to 2.50--	0.13 to 0.20--	Moderate.
B------	A-------	0 to 4---	Loam----------	Low----------	0.80 to 2.50--	0.13 to 0.20--	Moderate to high.
	C_{ca}-----	4 to 33--	Clay loam to loam--	Low----------	0.20 to 0.80--	0.13 to 0.20--	Moderate.
	C-------	33 to 60--	Clay loam to loam--	Low----------	0.20 to 0.80--	0.13 to 0.20--	High to low.

Soil name	Suitability of soil material for--			Suitable as source of--		
	Road subgrade	Road fill	Seeding and sodding	Sand	Gravel	Clay
Aberdeen silty clay loam	Fair to poor	Fair to poor	Fair to poor	No	No	No
Agar silt loam	Fair	Fair to good	Good	No	No	No
Bonilla loam	Fair	Fair to good	Good	No	No	No
Cavour loam or silt loam	Poor to fair	Poor	Poor to fair	No	No	No
Cresbard silt loam or loam	Fair to poor	Fair to poor	Good to fair	No	No	No
Eakin silt loam	Fair	Fair to good	Good	No	No	No
Exline silty clay or silty clay loam.	Poor	Poor	Poor to fair	No	No	No
Gann silt loam	Fair	Fair to good	Good	No	No	No
Hamerly loam	Fair to poor	Fair to poor	Good to fair	No	No	No
Hand loam	Good	Good	Good	No	No	No
Harriet silty clay loam	Poor	Poor	Poor to fair	No	No	No
Houdek loam	Fair	Fair to good	Good	No	No	No
Hoven silty clay loam	Poor	Poor	Fair to poor	No	No	No
Hurley silty clay	Poor	Poor	Fair to poor	No	No	No
LaDelle loam and silt loam	Fair to poor	Fair	Good	No	No	No
Lamoure silt loam	Fair	Fair	Good	No	No	No

Susceptibility to--		Suitability of soils for--		Soil features affecting--		
Frost action	Slides	Reservoir area	Embankments	Irrigation	Terraces	Waterways
Medium to high.	None--	Variable; may have coarse-textured substratum.	Good----------	Slow permeability; excessive amounts of salts in places.	(No problem)--	Deep, fertile soil.
Medium------	Low---	Good----------	Good----------	Variable substratum; may require drainage.	(No problem)--	Deep, fertile soil.
Medium------	None--	Good----------	Good----------	Substratum drainage usually needed.	In swales-----	Deep, fertile soil.
Medium------	None--	Good----------	Good----------	Saline substratum----	(No problem)--	Salts limit vegetative cover.
Medium------	None--	Good----------	Good----------	Slow permeability; excessive amounts of salts in places.	(No problem)--	Deep, fertile soil.
Medium to high.	Low---	Good----------	Good----------	Variable substratum; may require drainage.	(No problem)--	Deep, fertile soil.
Medium------	None--	Variable; check substratum.	Good----------	Saline substratum----	(No problem)--	Salts limit vegetative cover.
Medium to light.	None--	Good----------	Good----------	Substratum drainage may be required.	(No problem)--	Deep, fertile soil.
Medium to high.	None--	Good----------	Good----------	Drainage needed------	In swales-----	Highly calcareous.
Light to medium.	None--	Variable; check coarse material in substratum.	Fair to good--	Moderate permeability.	(No problem)--	Deep, fertile soil.
Medium------	None--	Variable; check substratum.	Good----------	Saline substratum----	Nearly level--	Salts limit vegetative cover.
Medium------	Low---	Good----------	Good----------	Moderate permeability; some stones present.	Complex slopes.	Deep, fertile soil.
High--------	None--	Good----------	Good----------	Saline substratum----	In depressions.	Salts may limit vegetative cover.
Medium------	None--	Good----------	Fair----------	Saline substratum----	Nearly level--	Salts may limit vegetative cover.
Medium------	None--	Variable; check substratum.	Good----------	Moderate permeability.	Nearly level--	Deep, fertile soil.
Medium to high.	None--	Variable; check substratum.	Good----------	Moderate permeability; may require drainage.	Nearly level--	Deep, fertile soil.

Soil name	Suitability of soil material for--			Suitable as source of--		
	Road subgrade	Road fill	Seeding and sodding	Sand	Gravel	Clay
Lane loam or silty clay loam-----	Fair to poor--	Fair----------	Good----------	No--	No-----	No-----
Lane silty clay----------	Poor----------	Poor----------	Fair----------	No--	May be-	Yes----
Lismas silty clay----------	Poor----------	Poor----------	Poor----------	No--	No-----	Yes----
Maddock sandy loam----------	Good----------	Good----------	Good----------	Yes-	No-----	No-----
McKenzie clay----------	Poor----------	Poor----------	Fair----------	No--	No-----	Yes----
Miranda silt loam or loam--------	Poor----------	Poor----------	Fair to poor-------	No--	No-----	No-----
Mondamin silty clay loam---------	Fair----------	Fair----------	Good----------	No--	No-----	No-----
Oahe loam----------	Good----------	Good----------	Fair----------	Yes-	Yes----	No-----
Orman silty clay----------	Poor----------	Poor----------	Fair----------	No--	No-----	Yes----
Promise silty clay----------	Poor----------	Poor----------	Fair----------	No--	No-----	Yes----
Raber loam----------	Fair----------	Fair to good--	Good----------	No--	No-----	No-----
Sioux loam----------	Good----------	Good----------	Fair----------	Yes-	Yes----	No-----
Spottswood loam----------	Good----------	Good----------	Fair----------	Yes-	Yes----	No-----
Tetonka silt loam----------	Poor----------	Poor----------	Fair----------	No--	No-----	May be-
Wessington loam----------	Good----------	Good----------	Fair----------	Yes-	Yes----	No-----

engineering properties of the soils--Continued

Susceptibility to--		Suitability of soils for--		Soil features affecting--		
Frost action	Slides	Reservoir area	Embankments	Irrigation	Terraces	Waterways
Medium------	None--	Variable; check substratum.	Good----------	Slow permeability; salts in places.	(No problem)--	Deep, fertile soil.
Medium------	None--	Variable; check substratum.	Good----------	Slow permeability; salts in places.	(No problem)--	Deep, fertile soil.
Medium to light.	High--	Variable; check substratum.	Very poor-----	Shale within 12 inches of the surface.	Shallow soil; steep slopes.	Shale limits depth of shaping.
Light to medium.	None--	Unsuitable-------	Unsuitable----	Rapid permeability---	Very sandy----	Very sandy.
Medium------	None--	Good-------------	Good----------	Slow permeability; saline.	In depressions.	Salts may limit vegetative cover.
Medium------	None--	Good-------------	Good----------	Saline substratum----	Complex slopes.	Salts limit vegetative cover.
Medium to light.	Low---	Variable; check substratum.	Good----------	Slow permeability----	(No problem)--	Deep, fertile soil.
Light-------	None--	Unsuitable-------	Poor----------	Gravel below a depth of 20 inches.	Moderately shallow to gravel.	Fertile soil; moderately shallow to gravel.
Medium------	None--	Good-------------	Good----------	Slow permeability; may be saline.	(No problem)--	Deep, fertile soil.
Medium------	High--	Good-------------	Good----------	Slow permeability; shale below a depth of 40 inches.	(No problem)--	Deep, fertile soil.
Medium------	None--	Good-------------	Good----------	Slow permeability----	Complex slopes.	Deep, fertile soil.
Light-------	None--	Unsuitable-------	Poor----------	Gravel below a depth of 10 inches.	Very shallow to gravel.	Gravel limits depth of shaping.
Light to high.	None--	Generally unsuitable.	Poor----------	Gravel below a depth of 30 inches.	Moderately shallow to gravel.	Fertile soil; moderately shallow to gravel.
High--------	None--	Good-------------	Good----------	Slow permeability----	In depressions.	Deep, fertile soil.
Light-------	None--	Unsuitable-------	Poor----------	Gravel below a depth of 30 inches.	Moderately shallow to gravel.	Fertile soil; moderately shallow to gravel.

TABLE 10.--Interpretations of engineering

Soil name	Suitability of soil material for--			Suitable as source of--		
	Road subgrade	Road fill	Seeding and sodding	Sand	Gravel	Clay
Williams loam----------	Fair----------	Good to poor--	Good----------	No--	No-----	No-----
Zahl loam----------	Fair----------	Fair to good--	Fair----------	No--	No-----	No-----

Dakota Department of Highways are defined as follows: Light--the soil has little or no heave when subjected to moisture and freezing; medium--the soil will heave to a degree (0.1 to 0.2 inch per foot of frost penetration) when subjected to moisture and freezing; high--the soil will heave substantially (0.2 inch or more per foot of frost penetration) when subjected to moisture and freezing.

Susceptibility to slides is determined by the kind of soil, its moisture condition, and its physiographic position.

Ratings for the suitability of soils for farm ponds are given in table 10. Also given are soil features affecting irrigation, terraces, and waterways. These are estimates of the soil properties that might affect the specified practice or construction. On-site investigations may be necessary to determine whether the agricultural practices or constructions are needed and whether the topography is suitable.

The suitability of a soil as a source of sand, gravel, and clay indicates the value of that soil for construction material. Information in table 10 and in other parts of this report will not give the exact location of suitable material or the quality of the material in individual borrow pits. Nevertheless, it will indicate soils where detailed exploration will likely produce desirable construction material.

Table 11 gives the results of tests conducted on samples from 29 modal profiles. Two or more profiles were sampled for some of the soils. All tests were conducted according to AASHO standard testing procedures. Test data in this table, as well as in table 12, were used as a basis for the estimates of soil properties in table 9 and for the ratings of soil materials for construction purposes in table 10.

The test for liquid limit measures the effect of water on the consistence of the soil material. As the moisture content of a clayey soil is increased from a dry state, the material changes from a semisolid to a plastic state. As the moisture content is further increased, the material changes from a plastic to a liquid state. The plastic limit is the moisture content at which the soil material passes from solid to plastic. The liquid limit is the moisture content at which the material passes from plastic to liquid. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is plastic.

Table 12 summarizes data obtained by the South Dakota Department of Highways as a result of their soil exploration and soil testing programs in Hand County. The soil samples were taken along proposed highway routes and tested in laboratories. These data, along with data on traffic intensity, precipitation, frost action, depth to water table, and kind of terrain, help to determine how thick the pavement needs to be to give adequate wheel-load support.

The locations and depths of the soil samples were matched with those of the soil mapping units, and the range and mean values of the test results of all samples within each mapping unit were determined. It should be remembered that for highway design purposes, samples are taken to represent only major differences in soil texture and color from place to place and also in the vertical sections. Because of this practice, more than one soil horizon may be represented in one engineering soil sample. The major horizon or horizons that the engineering samples are believed to represent are indicated on table 12.

Mechanical analysis and tests to determine liquid limit, plasticity index, maximum density, and optimum moisture content were performed according to AASHO procedure (1). Values for dry, loose weight of each sample were obtained by test procedure developed by the South Dakota Department of Highways.

Mechanical analysis, liquid limit, plasticity index, and dry, loose weight were determined for all the samples tested. Maximum density and optimum moisture content were obtained from some of the samples, generally one or two; these data were obtained by the Standard Proctor method.

If a soil material is compacted at successively higher moisture content, assuming that the compactive effort remains constant, the density of the compacted material will increase until the optimum moisture content is reached. After that, the density decreases with an increase in moisture content. The highest dry density obtained in the compaction test is termed the maximum density.

properties of the soils--Continued

Susceptibility to--		Suitability of soils for--		Soil features affecting--		
Frost action	Slides	Reservoir area	Embankments	Irrigation	Terraces	Waterways
Medium------	Low---	Good----------	Good----------	Moderate permeability; some stones.	Complex slopes.	Deep, fertile soil.
Light-------	Low---	Good----------	Good----------	Shallow soil in glacial till.	Complex and steep slopes.	Low fertility.

Unified and AASHO classifications given in table 12 are based on the mean values of the samples and do not indicate the classification of any one sample nor the range in classification of a specific soil horizon.

Genesis, Classification, and Morphology of the Soils

Soil is produced by the action of soil-forming processes on materials deposited or accumulated by geologic agencies. The characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent material, (2) the climate under which the soil material has accumulated and existed since accumulation, (3) the plant and animal life on and in the soil, (4) the relief or lay of the land, and (5) the length of time the forces of soil development have acted on the soil material.

A summary of the soil-forming factors in Hand County follows:

Parent material: Glacial till, outwash, loess, eolian sand, alluvium, and weathered Pierre shale.

Plant and animal life: Mainly grasses and various animals.

Climate: Subhumid to semiarid.

Relief: Hilly, rolling, undulating, nearly level, depressional.

Time: From the glacial period, or later, to the present.

Classification of the Soils

Soils are classified according to their chemical and physical characteristics. Most of their physical characteristics can be estimated in the field, but most chemical properties must be determined in the laboratory. Some chemical properties go along with physical properties that can be seen or measured, and so the physical properties (morphology) can be used to estimate them. Consequently, an important phase of soil classification is to determine the relationship of chemical properties to the morphology of the soil. Laboratory data for some of the soils of Hand County are given in table 13. The profiles analyzed are the same as, or comparable to, the profiles described under the heading "Descriptions of the Soil Series and Representative Profiles."

The lowest units of soil classification--the series and the type--are defined in the section "How Soils Are Named, Mapped, and Classified." Soil series are classified into the next higher category, the great soil group. Each great soil group is made up of soils that have the same general kind of profile but that differ in kind of parent material, in relief, or in degree of development. The soil series of Hand County have been placed in great soil groups, as follows:

Chernozems--
  Bonilla, Hand, Houdek, LaDelle, Lane, Maddock, Spottswood, Wessington.
Chestnut soils--
  Agar, Eakin, Gann, Mondamin, Oahe, Orman, Promise, Raber, Williams.
Humic Gley--
  Lamoure.
Regosols and Lithosols--
  Lismas, Sioux, Zahl.
Solodized-Solonetz soils--
  Aberdeen, Cavour, Cresbard, Exline, Harriet, Hoven, Hurley, McKenzie, Miranda.
Solonchak soils--
  Hamerly.
Soloth soils--
  Tetonka.

The principal characteristics of the soil series are described in table 14.

Chernozems and Chestnut soils

Chernozems and Chestnut soils are somewhat similar; Chernozems have formed in the subhumid area of South Dakota, and the Chestnut soils have formed in the semiarid part. Because the boundary between these two climatic zones passes through Hand County, differences in the soils caused by climate are not great. A Chernozem, such as Houdek loam, however, has a slightly thicker profile than its Chestnut counterpart, Williams loam. Thick profiles have formed in areas where precipitation is abundant and the soils are moist much

TABLE 11.--Engineering test data[1] for modal soils

Soil name	Horizon	Depth	Particle size distribution: Percentage passing sieve-- No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	Percentage smaller than-- 0.05 mm.	0.005 mm.	0.002 mm.	Liquid limit
		Inches								
Bonilla silt loam:										
Profile 1----------	A_1----------	0-5	100	100	97	80	76	41	24	----
	B_1----------	5-12	100	100	94	73	68	35	26	----
	B_{21}----------	12-17	100	100	94	68	62	34	28	----
	B_{22}----------	17-23	100	100	95	61	54	30	25	----
	B_{3ca}--------	23-40	100	97	90	68	64	35	26	----
	C_1----------	40-70	98	94	87	61	55	25	17	----
	C_2----------	70-84	100	97	89	68	64	29	21	----
Profile 2----------	A_{1p}---------	0-8	100	100	95	78	73	40	24	37
	B_1----------	8-14	100	100	96	78	73	37	22	35
	B_2----------	14-18½	100	100	94	75	67	39	30	39
	B_{cca}--------	18½-25	100	96	88	67	62	32	24	42
	C_{ca}---------	25-41	100	97	89	69	62	29	23	47
	C----------	41-60	99	96	87	71	64	32	24	37
Profile 3----------	A_{1p}---------	0-7	100	100	97	85	80	36	26	----
	A_1----------	7-13½	100	100	96	83	78	41	27	----
	B_{21}---------	13½-18	100	98	90	74	69	36	28	----
	B_{22}---------	18-27	100	98	92	72	66	36	27	----
	C_{ca1}--------	27-31	100	96	88	70	64	33	24	----
	C_{ca2}--------	31-42	100	97	90	72	65	31	23	----
	C----------	42-60	100	100	92	73	65	33	23	----
Cavour silt loam:										
Profile 1----------	A_{1p}---------	0-6	100	100	96	80	74	35	23	40
	A_2----------	6-8	100	99	94	78	77	32	18	----
	B_2----------	8-15	100	100	95	79	73	42	35	37
	B_3----------	15-21	100	99	94	72	63	40	34	52
	C_1----------	21-38	99	97	90	73	66	33	25	45
	C_2----------	38-60	99	96	88	68	66	31	19	33
Profile 2----------	A_1----------	0-7	100	100	92	67	63	27	18	----
	A_2----------	7-9	100	99	92	67	61	25	13	----
	B_2----------	9-16	100	99	94	73	68	41	36	----
	B_{3sa}--------	16-18	----	----	----	----	----	----	----	----
	C_{1sa}--------	18-33	99	98	90	71	66	37	31	----
	C_2----------	33-60	99	96	88	64	57	26	19	----

Cresbard loam----------	A_1----------	0-6	100	99	93	75	70	28	20	----
	A_2----------	6-9	100	100	96	80	70	37	26	----
	B_2----------	9-17	99	97	86	63	57	31	23	----
	B_3----------	17-29	100	100	96	84	80	41	32	----
	B_{3ca}--------	29-44	99	96	89	82	77	45	32	----
	C_1----------	44-66	100	95	86	66	55	16	18	----
Cresbard silt loam:										
Profile 1----------	A_{1p}---------	0-9	100	100	96	85	81	40	27	----
	A_2----------	9-14	100	100	97	67	83	42	32	----
	B_{21}---------	14-34	100	100	97	86	79	45	35	----
	B_{22}---------	34-41	100	99	92	77	67	42	35	----
	B_{3ca}--------	41-53	100	97	87	67	66	41	31	----
	C----------	53-60	100	96	86	70	56	51	50	----
Profile 2----------	A_{1p}---------	0-6	100	100	97	87	84	45	27	----
	A_{12}---------	6-11	100	100	97	87	85	37	37	----
	A_2----------	11-15	100	100	97	87	84	47	39	----
	B_{21}---------	15-21	100	100	96	84	80	47	36	----
	B_{22}---------	21-29	100	100	94	78	75	44	35	----
	B_{3ca}--------	29-40	100	97	91	72	66	34	26	----
	C----------	40-60	100	98	90	69	65	29	22	----
Eakin silt loam:										
Profile 1----------	A_1----------	0-$2\frac{1}{2}$	100	100	98	91	87	45	27	45
	B_1----------	$2\frac{1}{2}$-7	100	100	98	92	87	49	30	43
	B_2----------	7-12	100	100	99	93	88	49	31	45
	B_{2ca}--------	12-22	100	100	98	90	82	40	25	40
	D-B_{2ca}------	22-31	98	91	81	67	62	32	18	40
	D-B_{3cacs}----	31-37	100	96	88	76	72	43	31	57
	D_{cacs}-------	37-60	100	94	81	62	58	37	29	66
Profile 2----------	A_1----------	0-$3\frac{1}{2}$	100	100	99	93	89	45	26	55
	B_{21}---------	$3\frac{1}{2}$-8	100	100	99	94	91	53	34	45
	B_{22}---------	8-14	100	100	99	95	91	51	31	42
	B_{2ca}--------	14-19	100	100	99	95	89	41	26	41
	B_{3ca}--------	19-26	100	98	95	87	81	37	24	37
	D-B_{3cacs}----	26-35	100	98	93	79	73	40	29	44
	D-B_{3ca}------	35-42	100	100	98	90	87	54	40	56
	D_{ca}---------	42-60	98	94	87	72	67	37	28	56
Hand loam:										
Profile 1----------	A_p----------	0-6	100	99	92	62	53	22	15	29
	B ----------	6-20	100	99	91	60	49	20	15	33
	C_{ca}---------	20-33	99	98	91	65	53	24	19	36
	C_2----------	33-60	100	100	99	86	79	35	20	31
	C_3----------	60-82	100	99	96	82	63	20	8	----
	C_4----------	82-114	99	97	91	66	60	21	12	----
Profile 2----------	A_{1p}---------	0-8	100	100	93	69	62	30	20	----
	A_1-B--------	8-23	100	100	90	65	58	36	30	----
	B_3----------	23-32	100	99	87	53	41	7	4	----
	C_1----------	32-42	100	99	85	35	30	8	3	----
	C_2----------	42-60	100	99	85	40	32	7	3	----

TABLE 11.--Engineering test data[1] for modal soils--Continued

Soil name	Horizon	Depth	Particle size distribution							Liquid limit
			Percentage passing sieve--				Percentage smaller than--			
			No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.005 mm.	0.002 mm.	
		Inches								
Houdek loam:										
Profile 1----------	A_1----------	0-5	100	99	91	67	60	27	20	----
	B_1----------	5-7	100	99	89	63	56	28	22	----
	B_3----------	7-16	100	98	87	56	49	23	16	----
	C_{ca}---------	16-28	100	96	97	65	59	28	21	----
	C_2----------	28-60	100	97	90	71	63	25	17	----
Profile 2----------	A_{1p}---------	0-7	100	99	93	77	73	35	23	----
	B_1----------	7-14	100	99	93	76	72	39	31	----
	C_{ca}---------	14-24	100	100	97	90	89	35	27	----
	C_1----------	24-35	100	100	99	98	97	49	26	----
	C_{cs}---------	35-47	100	100	99	98	97	45	23	----
	C_2----------	47-60	98	95	87	66	66	26	18	----
Profile 3----------	A_{1p}---------	0-6	99	98	91	69	62	31	21	----
	B_1----------	6-16	100	99	92	69	63	36	29	----
	C_1----------	16-22	99	95	87	68	61	30	21	----
	C_{ca}---------	22-42	100	97	88	69	64	30	22	----
	C_{cs}---------	42-60	94	93	85	64	57	27	17	----
Profile 4----------	A_1----------	0-4	100	100	93	76	70	34	19	42
	B_{21}---------	4-10	100	99	92	71	59	34	24	38
	B_{22}---------	10-14	100	99	92	71	59	34	24	40
	C_{ca1}--------	14-25	100	97	88	68	61	31	24	40
	C_{ca2}--------	25-33	100	96	87	67	60	31	22	37
	C_1----------	33-45	100	96	87	68	59	35	20	38
	C_2----------	45-60	100	95	86	66	59	27	20	35
LaDelle silt loam:										
Profile 1----------	A_1----------	0-11	100	100	98	75	68	31	21	33
	AB----------	11-19	100	100	98	75	65	27	23	30
	B_1----------	19-29	100	100	100	79	68	27	21	31
	C_1----------	29-41	100	100	99	75	63	29	21	28
	C_2----------	41-60	100	100	99	76	64	26	16	34
Profile 2----------	A_{1p}---------	0-5	100	100	98	85	80	31	25	----
	A_{1b}---------	5-16	100	100	99	89	83	44	29	----
	C_{ca1}--------	16-31	100	100	98	76	66	32	23	----
	C_{ca2}--------	31-47	100	100	94	66	56	27	18	----
	C_1----------	47-60	100	100	98	78	69	29	20	----

LaDelle silt loam:										
Profile 1----------	A_1----------	0-9	100	100	99	92	88	44	32	41
	B_1----------	9-16	100	100	100	93	89	46	33	42
	A_{1b}---------	16-22	100	100	100	86	81	40	31	38
	C_1----------	22-29	100	100	100	85	77	35	26	34
	C_2----------	29-39	100	100	100	83	75	40	26	37
	A_{1b2}--------	39-60	100	100	100	88	83	33	23	44
Profile 2----------	A_{1p}---------	0-5	100	100	98	86	78	35	23	31
	A_{12}---------	5-10	100	100	100	87	85	46	32	28
	A_{1b}---------	10-15	100	100	98	74	61	29	21	30
	C_{1bca}-------	15-23	100	100	98	69	55	26	19	33
	A_{1b2}--------	23-31	100	100	98	90	87	44	33	32
	A_{1gca}-------	31-48	100	100	97	84	77	41	28	47
	A_{3gca}-------	48-60	100	99	92	74	68	31	18	38
Lane silty clay loam------	A_p----------	0-6	100	100	96	89	85	48	39	53
	A_{12}---------	6-13	100	100	96	87	84	50	44	55
	B_{21}---------	13-18	100	98	96	77	73	40	32	50
	B_{22}---------	18-35	100	99	91	72	66	34	24	43
	C_{ca}---------	35-49	100	98	89	69	63	28	20	35
	C----------	49-60	100	97	88	67	61	28	19	34
Mondamin silty clay loam:										
Profile 1----------	A_1----------	0-4	100	100	99	95	92	51	31	54
	B_{21}---------	4-9	100	100	99	97	94	58	40	51
	B_{22}---------	9-15	100	100	100	97	95	59	39	50
	B_{3ca1}-------	15-21	100	100	99	98	96	55	34	50
	B_{3ca2}-------	21-27	100	100	100	98	97	58	38	51
	B_{3ca3}-------	27-35	100	100	100	99	97	60	37	54
	B_{3cacs1}-----	35-43	100	100	100	100	98	62	38	57
	B_{3cacs2}-----	43-54	100	100	100	99	97	60	39	55
	C_{ca}---------	54-60	100	100	100	98	96	57	36	53
Profile 2----------	A_1----------	0-3	100	100	99	95	93	55	28	----
	B_{21}---------	3-9	100	100	100	98	96	61	40	----
	B_{22}---------	9-15	100	100	100	98	96	60	42	----
	B_{23}---------	15-19	100	100	99	98	96	58	36	----
	B_{2ca}--------	19-24	100	100	100	99	97	59	37	----
	B_{3ca}--------	24-35	100	100	100	99	97	59	36	----
	B_{3cacs1}-----	35-40	100	100	100	98	96	57	39	----
	B_{3cacs2}-----	40-52	100	100	100	98	96	60	38	----
	B_{3cacs3}-----	52-60	100	100	100	98	95	59	37	----
Promise clay----------	A_1----------	0-3	100	98	96	91	89	64	50	61
	B_{21}---------	3-10	100	100	98	94	93	71	60	62
	B_{22}---------	10-17	100	100	98	95	94	71	60	62
	B_{23}---------	17-28½	100	100	99	98	97	73	62	60
	$C\text{-}DB_{3cacs}$---	28½-34	100	100	100	99	98	73	60	65
	D_{cacs1}------	34-40	100	100	96	88	87	62	50	60
	D_{cacs2}------	40-50	100	100	97	92	90	68	54	66
	D_{cacs3}------	50-60	100	100	99	94	93	68	58	73

TABLE 11.--Engineering test data[1] for modal soils--Continued

Soil name	Horizon	Depth	Particle size distribution							Liquid limit
			Percentage passing sieve--				Percentage smaller than--			
			No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.005 mm.	0.002 mm.	
		Inches								
Promise silty clay--------	A_1----------	0-5	100	100	99	98	96	71	61	62
	B_{21}---------	5-11	100	100	99	98	97	71	63	62
	B_{22}---------	11-21	100	100	100	99	98	77	66	61
	B_{2ca}--------	21-31	100	100	100	99	98	77	66	73
	$C\text{-}DB_{3cacs}$---	31-35	100	100	98	93	91	55	26	69
	D_{cacs1}------	35-47	100	100	99	94	92	52	20	72
	D_{cacs2}------	47-60	100	100	97	94	93	56	30	75
Raber loam----------	A_1----------	0-3	100	100	93	81	78	41	24	54
	B_2----------	3-10	100	100	93	77	72	43	35	46
	B_{2ca}--------	10-15	100	100	93	73	70	42	32	45
	B_{3ca}--------	15-28	100	100	92	71	70	42	30	43
	$C\text{-}D_{ca}$-------	28-36	99	95	85	68	65	37	28	41
	D_{ca}---------	36-54	99	97	90	75	72	45	34	59
	D_{cacs}-------	54-60	100	96	89	75	71	43	33	52
Raber silty clay loam-----	A_1----------	0-3	99	95	91	83	80	40	24	53
	B_2----------	3-10	100	98	94	83	80	48	38	51
	B_{2ca}--------	10-14	100	96	89	77	74	44	31	53
	B_{2cacs}------	14-26	99	95	87	75	71	41	31	49
	B_{3cacs}------	26-38	99	96	89	74	70	38	29	46
	$C\text{-}D_{cacs}$-----	38-51	98	94	87	71	66	36	27	57
	D_{ca}---------	51-60	96	92	85	69	64	34	22	59
Williams loam:										
Profile 1----------	A_1----------	0-4	99	96	89	70	65	32	18	35
	B_{21}---------	4-8½	100	100	93	68	63	36	28	40
	B_{22}---------	8½-13	100	98	93	71	65	39	30	44
	B_{3ca}--------	13-21	100	96	89	71	65	37	30	44
	C_{cacs1}------	21-27	98	94	86	64	58	29	21	34
	C_{cacs2}------	27-36	99	94	85	61	54	23	15	34
	C_{cacs3}------	36-46	100	94	82	60	54	25	16	40
	C ----------	46-60	100	94	84	61	55	25	15	36

Profile 2----------	A_1----------	0-3	100	98	91	76	74	36	20	43
	B_{21}----------	3-7	100	98	89	70	68	41	28	41
	B_{22}----------	7-12	99	96	88	69	67	46	33	47
	B_{3ca}--------	12-21	100	97	89	69	66	42	32	44
	C_{ucal}-------	21-30	100	100	97	92	91	57	35	50
	C_{uca2}-------	30-37	100	98	97	95	94	58	35	58
	C_{uc}----------	37-45	100	100	96	88	86	51	29	59
	C_{ccs}--------	45-60	100	95	88	70	64	27	17	35

1/ Soil samples were tested at the South Dakota State College Soil Laboratory and at the Soil Survey Laboratory at Mandan, North Dakota. Liquid limits, plasticity indexes, and Unified and AASHO classifications are given for s college but not for those tested at Mandan.

TABLE 12.--Engineering soil test data by

Soil series	Horizon	Number of samples tested	Percentage of material passing sieve--						Percentage of material finer than 5 microns	
			No. 10		No. 40		No. 200			
			Range	Mean	Range	Mean	Range	Mean	Range	Mean
Bonilla	A	3	95-100	97	89-95	92	58-77	68	-------	------
	B	3	94-100	97	87-97	93	71-83	77	-------	------
	C	6	94-98	96	86-93	90	64-87	71	-------	------
Cresbard	A	1	99	99	97	97	81	81	-------	------
	B	1	98	98	93	93	79	79	-------	------
Gann	B	1	100	100	99	99	90	90	14	14
	C	1	98	98	95	95	76	76	20	20
Raber	A	5	98-100	99	95-97	96	76-87	82	9-16	12
	B	3	99-100	100	96-98	98	84-91	89	6-17	10
	C	7	96-100	98	90-99	94	71-93	82	19-33	24
Tetonka	A	1	98	98	94	94	80	80	12	12
	B	1	98	98	90	90	71	71	27	27
	C	1	98	98	94	94	80	80	12	12
Wessington	A	1	92	92	81	81	70	70	8	8
Williams	A	10	80-100	95	71-98	90	54-91	73	7-24	12
	B	12	94-100	98	82-97	93	42-90	75	8-24	14
	C	16	67-100	93	55-97	86	27-91	66	8-33	19
Zahl	A	4	90-100	97	78-98	90	74-76	73	4-14	8
	B	1	98	98	90	90	63	63	10	10
	C	6	93-100	95	78-98	87	50-73	64	14-29	19

of the time. But in the Chestnut area, the subsoil is frequently dry for a year or more before there is enough precipitation to moisten the entire profile.

Both the Chernozems and Chestnut soils have A, B, and C or D horizons. There is a zone of carbonate accumulation in the B, C, or D horizon. Most of the roots grow in the dark-colored A horizon. Moisture that reaches the subsoil passes first through the A horizon and washes out the more soluble minerals. In well-drained soils, the very soluble minerals are moved into the substratum. Some moderately soluble minerals, however, are deposited in the B or the C horizon as moisture is removed from those zones by roots. The depth to the zone of carbonate accumulation, mainly calcium carbonate, is a measure of the average depth that moisture penetrates in a well-drained soil developed in a dry climate. Most of the Chernozems and Chestnut soils in the county have Bca, Cca, or Dca horizons in which carbonates have accumulated. In addition, some have Bcs, Ccs, or Dcs horizons in which calcium sulfate (gypsum) has accumulated. Calcium sulfate is more soluble than calcium carbonate and, consequently, is washed to a lower layer in the profile.

Humic Gley soils

The Humic Gley soils, like the Solonchak soils, have formed in sites where the water table is high. In the Humic Gley soils, however, water moves more of the very soluble salts from the surface layer to the substratum. Both the Solonchak and Humic Gley soils generally have a dark-colored A horizon, a B horizon, in places, and a grayish or olive C or D horizon that has yellowish-brown mottles.

Regosols and Lithosols

Typically, a Regosol or a Lithosol has a thin A horizon that is underlain by a C horizon. A Regosol is underlain by sandy or other loose material; a Lithosol by hard rock or a mass of rock fragments. In this county, however, the typical Regosol or Lithosol is rare, and most of the Zahl, Lismas, and Sioux soils have a thin B horizon. The Zahl and Lismas soils are on steep slopes and are subject to rapid erosion. Zahl soils are underlain by glacial till, some of it gravelly. Lismas soils are underlain by weathered shale. The Sioux soils

Liquid limit		Plasticity index		Dry, loose weight		Maximum density		Optimum moisture content		Classification	
										Unified	AASHO
Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean		
				Lb./cu. ft.	Lb./cu. ft.	Lb./cu. ft.	Lb./cu. ft.	Percent	Percent		
38-44	40	14-19	17	60-77	66	----------	---------	-----	----	CL	A-6(10).
40-49	43	13-28	20	55-83	67	----------	---------	-----	----	CL	A-7-6(13).
35-47	39	16-21	19	61-85	68	----------	---------	-----	----	CL	A-6(11).
44	44	12	12	58	58	----------	---------	-----	----	ML	A-7-5(10).
52	52	34	34	67	67	----------	---------	-----	----	CH	A-7-6(18).
42	42	13	13	56	56	100	100	20	20	ML	A-7-6(10).
43	43	22	22	76	76	----------	---------	-----	----	CL	A-7-6(14).
39-49	44	12-18	15	54-67	63	102	102	20	20	ML	A-7-6(10).
46-48	47	14-20	17	53-75	62	----------	---------	-----	----	ML	A-7-5(12).
40-53	45	18-29	23	73-84	77	----------	---------	-----	----	CL	A-7-6(14).
50	50	21	21	59	59	----------	---------	-----	----	ML-CL	A-7-6(15).
45	45	25	25	77	77	----------	---------	-----	----	CL	A-7-6(14).
50	50	21	21	59	59	----------	---------	-----	----	ML-CL	A-7-6(15).
44	44	14	14	62	62	----------	---------	-----	----	ML	A-7-5(9).
40-58	44	15-20	19	59-72	66	96-112	100	15-23	20	ML-CL	A-7-6(14).
26-51	42	9-29	18	50-86	70	----------	---------	-----	----	ML-CL	A-7-6(12).
31-66	41	15-36	21	71-91	78	89	89	26	26	CL	A-7-6(11).
46-53	45	13-30	18	60-69	63	----------	---------	-----	----	ML-CL	A-7-6(12).
38	38	18	18	69	69	----------	---------	-----	----	CL	A-6(9).
27-46	37	11-28	18	60-87	77	----------	---------	-----	----	CL	A-6(9).

have formed in coarse material that is resistant to soil-forming processes.

Solodized-Solonetz soils

In solodized-Solonetz soils, the soluble salts have been removed from the upper part of the profile but not from the lower part of the B horizon or from the C horizon. There is a large amount of exchangeable sodium in the B horizon. The sodium makes the layer very dense and very slowly permeable. The B horizon is overlain either by a platy, grayish-colored A2 horizon and a dark-colored A1 horizon or by only a very thin, platy A2 horizon and no definite A1. The thickness of the A horizon is important, since plants grow readily in the friable soil material.

Some of the solodized-Solonetz soils in Hand County--the Miranda, Cavour, and Cresbard--differ distinctly from one another in the thickness of the A horizon and the content of sodium. Sodium is gradually removed at a very slow rate and over a long period from the upper B horizon of each of these soils. As a result, the columnar upper B horizon changes to a platy, friable, gray A2 horizon and, then, near the surface, to a dark-colored A1 horizon. However, as the combined A1 and A2 horizons become thicker and lose more sodium, the columnar structure of the remaining B horizon changes to blocky. The Miranda soils represent the first stage of this development; the Cavour soils, the second; and the Cresbard soils, the third. (See table 13.) Presumably, the Cresbard soils would in time develop characteristics similar to those of the Bonilla soils. Any change, however, that would stop the movement of water into the substratum and cause a high water table would tend to reverse the sequence of soil formation and to form again a soil like a solodized-Solonetz.

Solonchak soils

The soils of the Solonchak great soil group have developed in areas that frequently have a high water table. Moderately soluble salts and occasionally very soluble salts are not washed from the surface layer, because most of the water remains in this layer until it evaporates or is used by plants.

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TABLE 13.--Laboratory data

Soil, location, and sample number	Horizon	Particle size distribution in millimeters					Cation exchange capacity	Exchangeable cations (Milliequivalents per 100 grams)				
		Depth	Gravel (>2)	Sand (2-0.05)	Silt (0.05-0.002)	Clay (<0.002)		Ca	Mg	Na	K	H
		Inches	Percent	Percent	Percent	Percent	Meq./100 gm.					
Bonilla silt loam	A_1	0-5	----	23.5	52.9	23.6	28.0	16.5	4.6	0.3	1.3	9.2
Location: Sec. 20,	B_1	5-12	0.5	31.0	42.4	26.6	22.1	13.6	4.8	.2	1.1	4.5
T. 115 N., R. 67	B_{21}	12-17	.4	37.4	34.7	27.9	21.3	13.8	6.1	.4	1.3	2.5
W.; 75 ft. N.	B_{22}	17-23	----	45.7	29.3	25.0	18.1	13.7	5.1	.4	1.7	1.4
and 75 ft. E. of	B_{3ca}	23-40	2.6	33.8	38.1	28.1	15.4	----	---	.5	1.6	---
$W\frac{1}{4}$ cor.	C_1	40-70	5.5	39.4	37.9	22.7	14.5	----	---	1.2	1.3	---
Sample No.: 50-SD-30-1.	C_2	70-84	3.1	33.4	42.5	24.1	15.5	----	---	2.0	1.3	---
Cavour loam	A_1	0-7	----	37.3	44.8	17.9	18.9	9.4	4.4	.7	1.1	6.3
Location: Sec. 21,	A_2	7-9	1.2	38.2	47.8	14.0	12.1	4.8	4.8	2.2	1.0	2.1
T. 115 N., R. 67	B_2	9-16	.9	30.4	32.0	37.6	28.1	5.0	18.4	9.8	2.4	.3
W.; 1035 ft. W.	C_{1ca}	18-33	2.2	32.6	33.9	33.5	14.7	----	---	8.0	2.4	---
and 75 ft. N. of	C_2	33-60	3.7	38.9	38.0	23.1	15.1	----	---	7.1	2.5	---
SE cor.												
Sample No.: 50-SD-30-2.												
Cresbard silt loam	A_1	0-6	.6	29.5	49.9	20.6	22.8	13.5	4.7	.2	2.1	6.1
Location: Sec. 25,	A_2	6-9	----	30.4	45.9	23.7	18.5	10.1	5.6	.1	1.2	4.3
T. 115 N., R. 67	B_2	9-17	3.0	40.2	30.2	29.6	20.7	11.3	7.5	.3	.1	3.0
W.; 42 ft. E.	B_3	17-29	----	19.8	46.9	33.3	22.7	----	---	.1	.2	2.1
and 15 ft. S. of	B_{3ca}	29-44	3.9	28.1	45.0	26.9	16.2	----	---	.4	.2	---
$W\frac{1}{4}$ cor.	C_1	44-66	4.7	40.8	36.9	22.3	13.6	----	---	1.5	.0	---
Sample No.: 50-SD-30-4.												
Eakin silt loam	A_p	0-4	(1/)	11.0	62.6	26.4	27.5	20.0	5.8	---	1.7	5.9
Location: Sec. 15,	B_{21}	4-8	----	9.4	56.3	34.3	27.0	17.4	7.1	---	1.3	5.0
T. 109 N., R. 69	B_{22}	8-14	----	9.1	59.5	31.4	24.6	18.3	6.8	.1	.7	3.0
W.; 370 ft. S.	B_{2ca}	14-19	----	11.2	63.1	25.7	18.2	----	---	.1	.4	---
and 90 ft. W. of	B_{3ca}	19-26	2.3	16.8	57.2	26.0	17.9	----	---	.2	.4	---
NE cor.	$D\text{-}B_{3cacs}$	26-35	2.4	24.6	44.0	31.4	21.0	----	---	1.4	.4	---
Sample No.: 56-SD-33-10.	$D\text{-}B_{3ca}$	35-42	(1/)	12.9	47.0	40.1	23.4	----	---	3.4	.4	---
	D_{ca}	42-60	5.8	27.4	38.4	34.2	22.2	----	---	5.2	.6	---
Hand loam	A_1	0-6	1.4	46.0	37.4	16.6	16.4	11.0	3.6	.4	.4	2.6
Location: Sec. 2,	B	6-20	.7	48.9	33.7	17.4	16.0	11.7	4.2	.4	.2	1.4
T. 114 N., R. 66	C_{ca}	20-33	1.8	45.1	35.6	19.3	8.7	----	---	.6	2.3	---
W.; 0.15 mile N.	C_2	33-60	----	30.8	58.9	10.3	8.4	----	---	1.2	3.2	---
and 40 ft. E. of	C_3	60-82	1.1	36.4	54.1	9.5	8.5	----	---	1.4	2.1	---
SW cor.	C_4	82-114	2.5	38.9	47.6	13.5	10.4	----	---	1.6	1.8	---
Sample No.: 50-SD-30-5.												
Houdek loam	A_1	0-5	1.5	38.5	40.3	21.2	21.2	13.4	5.4	.2	.5	3.7
Location: Sec. 22,	B_{21}	5-11	1.1	42.6	34.5	22.9	18.5	11.6	6.0	.2	.0	1.6
T. 115 N., R. 67	B_{22}	11-16	2.1	48.7	33.0	18.3	14.9	----	---	.2	.8	---
W.; 230 ft. N.	B_{3ca}	16-28	4.4	36.3	38.6	25.1	14.9	----	---	.6	1.8	---
and 230 ft. E. of	C	28-60	3.1	33.5	46.4	20.1	14.2	----	---	1.2	2.6	---
SW cor.												
Sample No.: 50-SD-30-3.												

for important soils

Soluble cations (Milliequivalents per liter)				Moisture at saturation	Electrical conductivity ($Ec_3 \times 10$)	Reaction		Calcium carbonate equivalent	Gypsum	Organic carbon	Nitrogen	Moisture held at tension of--		
						Saturated paste	1:10					1/10 atmos.	1/3 atmos.	15 atmos.
Na	K	Ca	Mg											
				Percent		pH	pH	Percent	Meq./100 gm.	Percent	Percent	Percent	Percent	Percent
0	0.1	---	---	----	0.2	6.1	6.6	(1/)	----	4.61	0.337	----	31.6	19.0
(1/)	(1/)	---	---	----	.2	6.2	7.0	(1/)	----	1.61	.142	----	23.4	13.1
0	(1/)	---	---	----	.2	6.5	7.4	(1/)	----	.83	.082	----	22.5	12.7
0	0	---	---	----	.4	7.0	7.9	(1/)	----	.68	.077	----	19.6	11.2
(1/)	.1	---	---	----	.4	7.8	8.9	19.2	----	.53	.059	----	15.7	10.6
1.0	.2	---	---	----	6.0	7.9	8.7	13.4	----	.17	.024	----	22.3	10.5
1.0	.2	---	---	----	7.5	7.9	8.7	12.8	----	.16	.022	----	26.0	12.1
.1	.1	---	---	----	.4	6.1	6.8	(1/)	----	2.03	.168	----	35.0	9.2
.2	.1	---	---	----	.7	7.2	8.3	.0	----	1.10	.099	----	19.0	7.1
3.2	.4	---	---	----	5.0	7.9	9.0	(1/)	----	.71	.080	----	36.3	23.6
6.4	.4	---	---	----	13.0	8.6	8.9	23.2	25.9	.21	.026	----	22.1	11.9
9.2	.4	---	---	----	16.0	8.1	9.0	12.7	1.5	.14	.020	----	24.7	12.4
(1/)	.1	---	---	----	.3	6.0	6.8	(1/)	----	2.71	.221	----	28.2	15.0
(1/)	(1/)	---	---	----	.2	6.1	6.8	.0	----	.96	.103	----	22.9	13.0
0	0	---	---	----	.2	6.1	7.1	.0	----	.59	.068	----	24.1	13.5
(1/)	(1/)	---	---	----	.4	7.1	8.1	.7	----	.61	.071	----	26.1	15.2
(1/)	(1/)	---	---	----	.5	7.8	9.0	18.3	----	.34	.043	----	23.4	10.7
.3	.2	---	---	----	3.0	8.0	9.0	14.7	----	.22	.026	----	21.5	9.9
.4	1.0	5.3	2.8	75.7	.9	6.8	6.9	1	----	4.62	.361	47.1	31.3	15.4
.3	.5	3.6	1.9	62.4	.6	6.1	6.5	1	----	2.31	.203	38.2	27.9	15.6
.3	.3	4.6	2.5	61.0	.7	6.9	7.3	1	----	1.50	.149	38.2	27.4	13.6
.3	.2	3.4	2.1	57.3	.6	7.9	8.3	16	----	.99	.105	34.5	25.1	11.2
1.0	.2	2.5	2.9	52.2	.7	7.9	8.5	15	----	.54	.065	33.2	24.0	10.9
4.2	.1	1.1	2.3	59.5	.8	8.0	8.9	15	----	.33	----	35.2	27.1	13.5
6.9	.1	.4	.8	85.9	.8	8.4	9.0	21	----	.36	----	44.8	37.2	17.6
9.0	.1	.4	.2	91.6	1.0	8.6	9.3	12	----	.30	----	43.0	34.3	17.3
0	(1/)	---	---	----	.2	6.4	7.1	(1/)	----	1.54	.130	----	18.4	8.0
0	0	---	---	----	.2	6.8	7.6	0	----	.76	.083	----	16.5	8.5
0	(1/)	---	---	----	.4	7.6	8.9	21.7	----	.45	.052	----	15.6	6.3
.3	.1	---	---	----	1.8	8.2	9.1	18.2	----	.22	.023	----	19.5	5.7
.5	.2	---	---	----	4.4	7.9	8.8	14.5	----	.13	.016	----	17.8	5.7
1.2	.3	---	---	----	6.5	7.8	8.5	12.3	12.3	.11	.016	----	21.2	8.0
(1/)	(1/)	---	---	----	.3	6.0	7.1	(1/)	----	2.67	.218	----	23.7	13.7
(1/)	0	---	---	----	.2	6.9	7.6	(1/)	----	.94	.089	----	19.7	11.1
0	0	---	---	----	.4	7.4	8.4	1.7	----	.73	.083	----	16.4	9.3
0	0	---	---	----	.4	7.9	9.0	18.3	----	.47	.058	----	22.2	10.5
.2	.1	---	---	----	.8	8.4	9.4	14.1	----	.17	.021	----	25.2	10.4

TABLE 13.--Laboratory data

Soil, location, and sample number	Horizon	Depth	Particle size distribution in millimeters				Cation exchange capacity	Exchangeable cations (Milliequivalents per 100 grams)				
			Gravel (>2)	Sand (2-0.05)	Silt (0.05-0.002)	Clay (<0.002)		Ca	Mg	Na	K	H
		Inches	Percent	Percent	Percent	Percent	Meq./100 gm.					
LaDelle silt loam	A_{1p}	0-5	---	20.5	54.8	24.7	27.0	----	---	.4	2.8	---
Location: Sec. 31,	B_2	5-16	---	16.6	54.3	29.1	27.4	----	---	.1	1.3	---
T. 113 N., R. 66	B_{ca}	16-31	---	33.9	43.6	22.5	15.2	----	---	.8	.4	---
W.; 150 ft. S.	C_{ca}	31-47	.5	41.1	38.0	20.9	13.6	----	---	2.2	.2	---
and 30 ft. W. of	C_1	47-60	.1	31.4	48.0	20.6	13.5	----	---	2.3	.1	---
sec. center.												
Sample No.: 52-SD-30-4.												
LaDelle silty clay loam, fans, nearly level	A_{1p}	0-6	---	15.1	46.7	38.2	33.6	----	---	---	2.3	---
	B_2	6-13	.2	15.9	39.6	44.5	32.1	----	---	---	1.0	---
	B_{2ca}	13-18	1.7	25.2	41.0	33.8	22.1	----	---	---	.7	---
Location: Sec. 34,	B_{3ca}	18-35	1.3	33.1	41.2	25.7	15.4	----	---	.2	.4	---
T. 112 N., R. 66	C_{ca}	35-49	2.5	34.9	42.7	22.4	15.0	----	---	.3	.3	---
W.; 400 ft. N.	C	49-60	3.3	35.7	41.9	22.4	15.0	----	---	.7	.2	---
and 120 ft. E. of SW cor.												
Sample No.: 52-SD-30-1.												
Mondamin silty clay loam	A_1	0-4	---	8.0	61.1	30.9	29.3	24.1	7.2	---	1.9	5.1
	B_{21}	4-9	---	5.8	54.5	39.7	32.8	20.2	9.3	.1	1.3	5.6
Location: Sec. 2,	B_{22}	9-15	---	5.4	56.1	38.5	30.7	24.9	10.6	.1	.9	1.7
T. 110 N., R. 70	B_{3ca1}	15-21	---	4.4	61.3	34.3	24.1	----	---	.2	.6	---
W.; 415 ft. N.	B_{3ca2}	21-27	---	2.8	59.5	37.7	23.9	----	---	.6	.6	---
and 0.4 mile E.	B_{3ca3}	27-35	---	2.6	60.1	37.3	23.2	----	---	1.6	.5	---
of SW cor.	B_{3cacs1}	35-43	---	2.0	60.1	37.9	23.9	----	---	2.4	.6	---
Sample No.: 56-SD-33-5.	B_{3cacs2}	43-54	---	2.9	58.1	39.0	25.2	----	---	3.0	.8	---
	C_{ca}	54-60	---	4.5	59.8	35.7	25.2	----	---	3.1	1.0	---
Promise clay	A_1	0-3	1.8	9.0	39.6	51.4	38.4	32.3	5.0	.1	4.5	4.7
Location: Sec. 32,	B_{21}	3-10	---	7.3	33.1	59.6	36.4	44.4	4.2	---	3.3	---
T. 111 N., R. 70	B_{22}	10-17	---	6.0	33.7	60.3	33.4	44.0	4.6	.1	2.0	---
W.; 185 ft. N.	B_{23}	17-28	(1/)	3.4	34.2	62.4	31.8	42.0	6.6	.2	1.8	---
and 990 ft. W. of	$C\text{-}DB_{3cacs}$	28-34	---	2.3	37.6	60.1	30.8	----	---	.3	1.9	---
S. fork of E-W	D_{cacs1}	34-40	---	13.1	37.0	49.9	20.9	----	---	.2	1.7	---
Rd., near sec.	D_{cacs2}	40-50	---	10.5	35.9	53.6	29.3	----	---	.9	4.0	---
center.	D_{cacs3}	50-60	---	7.1	35.2	57.7	31.1	----	---	2.7	5.5	---
Sample No.: 56-SD-33-3.												
Raber silty clay loam	A_1	0-3	5.0	14.8	55.9	29.3	28.0	20.8	5.8	.1	2.0	4.6
Location: Sec. 16,	B_2	3-10	2.0	18.3	42.2	39.5	32.0	23.6	8.4	.1	1.2	3.8
T. 109 N., R. 69	B_{2ca}	10-14	3.6	22.3	43.3	34.4	26.6	----	---	.1	.8	---
W.; 215 ft. W.	B_{2cacs}	14-26	5.0	23.6	40.0	36.4	25.5	----	---	.4	.6	---
and 0.2 mile S.	B_{3cacs}	26-38	3.9	26.4	40.4	33.2	22.3	----	---	2.0	.5	---
of NE cor.	$C\text{-}D_{cacs}$	38-51	5.5	28.4	38.8	32.8	23.0	----	---	4.3	.7	---
Sample No.: 56-SD-33-9.	D_{ca}	51-60	8.1	27.6	41.8	30.6	22.3	----	---	5.0	.8	---

for important soils--Continued

Soluble cations (Milliequivalents per liter)				Moisture at saturation	Electrical conductivity ($Ec_3 \times 10$)	Reaction		Calcium carbonate equivalent	Gypsum	Organic carbon	Nitrogen	Moisture held at tension of--		
Na	K	Ca	Mg			Saturated paste	1:10					1/10 atmos.	1/3 atmos.	15 atmos.
				Percent		pH	pH	Percent	Meq./100 gm.	Percent	Percent	Percent	Percent	Percent
(1/)	---	---	---	----	.6	6.5	7.2	---	----	3.13	----	49.5	29.9	13.7
(1/)	---	---	---	----	.4	7.6	7.4	---	----	1.99	----	47.9	29.0	14.2
.5	---	---	---	----	2.3	7.8	9.0	11	----	.61	----	39.2	23.1	10.5
1.0	---	---	---	----	2.6	8.4	9.6	12	----	.27	----	35.0	22.8	9.6
.7	---	---	---	----	1.5	8.4	9.8	18	----	.15	----	33.3	23.5	9.4
(1/)	(1/	---	---	----	.4	6.4	7.2	(1/)	----	3.28	----	46.6	38.8	17.4
(1/)	(1/	---	---	----	.5	7.6	8.1	(1/)	----	1.65	----	47.4	35.9	18.9
(1/)	---	---	---	----	.4	7.6	8.8	11	----	.98	----	35.0	27.2	13.9
(1/)	---	---	---	----	.4	7.7	9.0	20	----	.39	----	30.9	23.2	10.2
.1	---	---	---	----	.5	7.9	9.2	18	----	.23	----	31.4	23.6	10.4
.2	---	---	---	----	.7	8.1	8.9	15	----	.18	----	31.3	23.7	10.8
.4	1.2	6.7	3.4	74.6	1.1	6.8	6.8	1	----	4.16	.348	48.2	33.2	15.8
.3	.5	3.2	2.7	64.0	.6	6.2	6.5	1	----	2.27	.206	41.2	31.6	17.6
.3	.4	4.8	3.8	66.2	.9	7.0	7.7	2	----	1.46	.137	38.0	31.1	16.8
.7	.3	3.3	3.4	59.3	.7	7.6	8.5	16	----	.86	.097	38.0	29.5	14.3
2.1	.2	1.7	3.3	63.8	.7	7.8	8.6	19	----	.54	.064	42.9	33.5	15.3
4.2	.1	.6	1.7	66.7	.6	7.9	8.4	17	----	.36	----	44.7	36.1	16.1
5.2	.1	.3	1.1	73.3	.7	8.0	8.6	15	----	.29	----	46.4	37.1	17.0
6.5	.1	.2	1.2	78.1	.8	8.1	8.4	12	----	.29	----	49.8	40.7	18.8
9.0	.2	.5	2.5	70.8	1.2	8.0	8.4	10	----	.29	----	48.1	39.3	17.6
1.0	3.0	12.8	3.1	77.4	1.7	6.6	6.8	---	----	4.92	.342	40.2	36.5	21.4
.2	1.4	5.4	1.1	76.7	.8	7.3	8.1	5	----	2.14	.221	38.2	36.2	22.1
.3	.8	5.0	1.2	77.4	.7	7.5	8.1	10	----	1.62	.157	38.5	35.5	21.2
.5	.7	4.6	.8	79.3	.7	7.6	8.3	11	----	1.06	.120	39.2	36.6	21.3
1.0	1.6	27.2	6.0	84.5	2.6	7.4	7.9	10	11	.87	----	40.9	37.3	21.2
1.5	2.2	29.5	3.9	87.7	2.8	7.3	7.8	6	225	.40	----	39.8	35.7	23.8
4.4	4.1	27.7	29.3	89.3	3.4	7.6	7.8	8	76	.26	----	47.1	43.0	24.9
15.2	5.6	24.3	8.9	98.8	5.4	7.8	7.9	9	62	.21	----	51.6	46.8	26.3
.4	1.2	5.4	2.5	75.9	.9	6.7	7.0	1	----	3.97	.317	41.2	30.6	15.7
.2	.4	4.3	2.3	62.7	.7	6.7	7.2	1	----	1.76	.171	33.5	29.1	17.9
.3	.3	4.6	2.5	58.8	.7	7.6	8.5	14	----	1.25	.133	31.1	26.0	14.8
1.1	.2	2.8	2.5	62.5	.6	7.8	8.6	20	----	.62	.075	34.1	27.2	14.7
4.3	.1	.7	1.1	60.6	.7	8.0	9.0	15	----	.28	----	34.9	28.9	14.8
6.6	.1	.3	.2	84.3	.7	8.4	9.3	11	----	.19	----	41.6	32.9	16.8
8.0	.1	.5	.2	87.6	.8	8.5	9.4	11	----	.20	----	45.3	36.8	17.4

TABLE 13.--Laboratory data

Soil, location, and sample number	Horizon	Particle size distribution in millimeters					Cation exchange capacity	Exchangeable cations (Milliequivalents per 100 grams)				
		Depth	Gravel (>2)	Sand (2-0.05)	Silt (0.05-0.002)	Clay (<0.002)		Ca	Mg	Na	K	H
		Inches	Percent	Percent	Percent	Percent	Meq./100 gm.					
Williams loam	A_1--------	0-4	3.5	31.9	46.4	21.7	20.0	13.4	4.7	---	1.6	2.1
Location: Sec. 5,	B_{21}-------	4-8	(1/)	36.7	35.7	27.6	22.1	14.6	6.7	---	1.0	2.9
T. 114 N., R. 70	B_{22}-------	8-13	1.5	33.6	35.3	31.1	23.3	17.8	7.8	---	.6	1.7
W.; 210 ft. N.	B_{3ca}------	13-21	4.2	30.7	35.5	33.8	17.3	----	---	.1	.4	---
and 100 ft. E.	C_{cacs1}----	21-27	6.1	35.6	37.5	26.9	14.8	----	---	.4	.4	---
of $W\frac{1}{4}$ cor.	C_{cacs2}----	27-36	5.6	40.3	39.2	20.5	13.3	----	---	1.3	.3	---
Sample No.: 56-SD-	C_{cacs3}----	36-46	6.5	39.8	37.7	22.5	15.1	----	---	3.1	.4	---
33-1.	C---------	46-60	6.1	39.1	39.5	21.4	14.9	----	---	3.8	.4	---

1/ Trace.

Soloth soils

Soloth soils represent a theoretical stage in the transformation of a solodized-Solonetz soil into a Chestnut or Chernozem soil. In the Soloth soils, exchangeable sodium is replaced by exchangeable hydrogen, and, consequently, acid soils are formed. In Hand County only the Tetonka soils have been placed in the Soloth great soil group. Although the Tetonka soils have some characteristics of Soloth soils, they are dominantly calcium soils. Possibly, they should be considered as intergrades between the Soloth and Planosol great soil groups. Planosols have a dense claypan that is low in exchangeable sodium.

Descriptions of the Soil Series and Representative Profiles

On the following pages are detailed descriptions of each of the soil series in Hand County. The symbols used in the profile descriptions to express color are Munsell color notations (8). In the descriptions of color in words, the range given is that from the dry to the moist soil.

Boundaries of soil horizons might be located at different places in some of the profiles by other observers. Significant boundaries of the classes of texture, color, structure, and other soil characteristics in some profiles do not exactly coincide. The boundaries and thickness recorded for each horizon depend on the significance placed on the particular combination of soil characteristics.

ABERDEEN SERIES

The soils of the Aberdeen series are deep, but they have a claypan below the plow layer. These soils belong to the solodized-Solonetz great soil group. They are moderately well drained to somewhat poorly drained and are made up of alluvium deposited on nearly level terraces along streams. Most of the areas are too high above the streams to be flooded. The Aberdeen soils occur in association with LaDelle silty clay loams.

A profile 777 feet west and 72 feet north of the SE cor. of sec. 9, T. 113 N., R. 70 W., is as follows:

Ap 0 to 5 inches, dark-gray to very dark brown (10YR 4/1-4/2, dry; 2/2, moist) fine silt loam or coarse silty clay loam; dark grayish brown to very dark brown (10YR 4/2, dry; 2/2, moist) when crushed; soft; moderately weak, very fine, granular structure; few, fine quartz grains; clear, smooth boundary.

A2 5 to 9 inches, dark-gray to very dark gray (10YR 4/1-4/2, dry; 3/1-2/2, moist) coarse silty clay loam; gray to very dark gray (10YR 5/1, dry; 3/1-2/2, moist) when crushed; soft; irregular, very weak, fine, prismatic and moderately weak, fine, granular to platy structure; few, fine, clear quartz grains; abrupt, smooth boundary.

B21 9 to 14 inches, dark-gray to very dark grayish-brown (10YR 4/1, dry; 2.5Y 3/2, moist) fine silty clay loam; dark grayish brown to very dark brown (2.5Y 4/2, dry; 10YR 2/2, moist) when crushed; very hard; moderate, fine, columnar structure that breaks to moderate, fine, subangular blocky; moderate, continuous coatings on the peds; few, clear and dark quartz grains; clear, smooth boundary.

B22 14 to 22 inches, dark grayish-brown to very dark grayish-brown (2.5Y 4/2, dry; 3/2, moist) fine silty clay loam; same color when crushed; very hard; moderately weak, fine, columnar and moderately weak, fine, subangular blocky

for important soils--Continued

Soluble cations (Milliequivalents per liter)				Moisture at saturation	Electrical conductivity ($Ec_3 \times 10$)	Reaction		Calcium carbonate equivalent	Gypsum	Organic carbon	Nitrogen	Moisture held at tension of--		
Na	K	Ca	Mg			Saturated paste	1:10					1/10 atmos.	1/3 atmos.	15 atmos.
				Percent		pH	pH	Percent	Meq./100 gm.	Percent	Percent	Percent	Percent	Percent
.5	1.5	4.8	2.8	50.3	.9	7.0	7.1	---	----	2.60	.216	35.0	21.8	10.1
.4	.5	3.3	2.5	47.9	.6	6.4	6.9	---	----	1.23	.134	31.0	22.6	12.1
.5	.3	5.1	3.6	50.7	.8	7.0	7.3	---	----	.99	.104	30.8	23.2	12.3
.5	.2	2.4	3.6	52.2	.6	7.7	8.5	21	----	.74	.076	31.9	24.2	11.1
1.8	.2	1.8	3.7	44.1	.7	7.9	8.7	17	----	.41	.044	32.5	23.8	9.9
5.2	.1	.7	1.9	44.6	.8	8.2	9.1	14	----	.28	----	30.8	22.6	9.0
15.7	.1	1.0	3.2	51.2	2.2	8.3	9.2	14	----	.26	----	34.9	26.6	10.8
36.5	.3	6.8	20.8	48.0	5.6	8.0	8.9	12	----	.24	----	32.8	24.9	10.2

structure; moderate, continuous coatings on the peds; clear, smooth boundary.

B31 22 to 32 inches, grayish-brown to very dark grayish-brown (2.5Y 5/2, dry; 3/2, moist) fine silty clay loam; same color when crushed; very hard; weak, medium, columnar and weak, fine, subangular blocky structure; thin, continuous coatings on the blocky peds; violent effervescence with acid; few carbonate segregations; clear, smooth boundary.

B3ca 32 to 44 inches, gray to dark-gray (2.5Y 5/1, dry; 4/1, moist) fine silty clay loam; gray to very dark gray (2.5Y 5/1-5/2, dry; 3/1, moist) when crushed; very hard; irregular, weak, medium, columnar and weak, fine, subangular blocky structure; thin, discontinuous coatings on the blocky peds; violent effervescence with acid; common carbonate segregations; layer may contain a few salt crystals; clear, smooth boundary.

B33 44 to 66 inches, gray to dark grayish-brown (2.5Y 5/1, dry; 4/2, moist) fine silty clay loam; same color when crushed; very hard; irregular, weak, medium, prismatic and weak, fine, subangular blocky structure; thin, discontinuous coatings on the blocky peds; violent effervescence with acid; few carbonate segregations.

The surface layer generally is silty clay loam, but in some areas it is loam or silt loam. The A2 horizon ranges from coarse silty clay loam to silt loam or loam. Because of dispersion, the material in the B2 horizon has properties similar to clay but its texture is silty clay loam, clay loam, or silty clay. The lower part of the B horizon and the C horizon generally are silty clay loam, but they may contain stratified material that ranges from silty clay to loam. In a few places, the substratum has sandy and gravelly layers. Buried, dark-colored layers, which were formerly surface layers, are in the subsoil in some areas.

AGAR SERIES

The Agar series consists of deep, medium-textured soils of the uplands. These soils are well drained or moderately well drained. They belong to the Chestnut great soil group. The parent material is loess that was deposited in the Wisconsin glacial stage.

In Hand County the Agar soils are underlain at a depth of 30 inches or more by glacial till of clay loam texture. In many places there is a layer, several inches thick, of stratified sand, silt, and clay between the loess and the till.

A profile 400 feet east and 195 feet north of the NW cor. of SW1/4SW1/4 sec. 24, T. 109 N., R. 67 W., is as follows:

Ap 0 to 8 inches, dark-gray to very dark brown (10YR 4/1, dry; 10YR 2/2, moist) silt loam; dark gray to very dark gray (10YR 4/1, dry; 3/1, moist) when crushed; slightly hard; clods break to very weak, very fine, granular structure; abrupt, smooth boundary.

B21 8 to 14 inches, dark grayish-brown to very dark grayish-brown (10YR 4/2, dry; 3/2, moist) silty clay loam or silt loam; same color when crushed; hard; weak, fine, prismatic and weak, very fine, subangular blocky to granular structure; thin, discontinuous coatings on the peds; pores the size of pinholes; clear, smooth boundary.

B22 14 to 20 inches, grayish-brown to dark-brown (2.5Y 5/2, dry; 4/3, moist) silt loam; light brownish gray to dark grayish brown (2.5Y

TABLE 14.--Principal characteristics of the soil series

Soil series	Parent material	Physiographic position	Dominant relief	Natural drainage	Dominant texture of profile	Consistence of subsoil (moist)
Aberdeen---	Alluvium----------	Terraces or flood plains.	Level--------	Imperfect---	Moderately fine-	Very firm.
Agar-------	Loess-------------	Uplands--------	Sloping------	Good--------	Medium----------	Friable.
Bonilla----	Local alluvium or glacial till.	Uplands--------	Nearly level-	Moderate----	Medium----------	Friable.
Cavour-----	Local alluvium, glacial till, or loess.	Uplands--------	Level or depressional.	Imperfect---	Moderately fine-	Very firm.
Cresbard---	Local alluvium and till.	Upland flats or drainageways.	Level or depressional.	Moderate----	Medium----------	Friable to firm.
Eakin------	Loess and glacial till.	Uplands--------	Sloping------	Good--------	Medium----------	Friable.
Exline-----	Alluvium----------	Uplands and flood plains.	Level--------	Poor to moderate.	Fine------------	Extremely firm.
Gann-------	Alluvium----------	Uplands--------	Sloping------	Good to moderate.	Medium----------	Friable.
Hamerly----	Glacial till-------	Uplands--------	Level--------	Imperfect---	Medium----------	Friable.
Hand-------	Outwash-----------	Uplands--------	Nearly level-	Good to moderate.	Medium----------	Friable.
Harriet----	Alluvium----------	Flood plains---	Level--------	Poor to imperfect.	Moderately fine-	Very firm.
Houdek-----	Glacial till-------	Uplands--------	Undulating---	Good--------	Medium----------	Friable.
Hoven------	Local alluvium-----	Basins---------	Flat---------	Poor--------	Fine------------	Extremely firm.
Hurley-----	Alluvium----------	Terraces-------	Nearly level-	Imperfect to poor.	Fine------------	Extremely firm.
LaDelle----	Alluvium----------	Terraces and flood plains.	Level--------	Good to moderate.	Medium to moderately fine.	Friable.
Lamoure----	Alluvium----------	Flood plains---	Level--------	Poor--------	Moderately fine-	Friable to firm.
Lane-------	Local alluvium and glacial drift.	Colluvial slopes.	Sloping------	Good to poor.	Medium to fine--	Friable to very firm.
Lismas-----	Weathered shale----	Uplands--------	Hilly--------	Excessive---	Fine------------	Firm.
Maddock----	Sandy outwash reworked by wind.	Uplands--------	Undulating---	Good--------	Coarse----------	Loose.
McKenzie---	Alluvium----------	Old flood plains.	Level--------	Poor--------	Fine------------	Extremely firm.
Miranda----	Till, loess, or local alluvium.	Uplands--------	Level--------	Moderate to imperfect.	Medium to moderately fine.	Very firm.
Mondamin---	Melt-water deposits.	Uplands--------	Undulating---	Good to moderate.	Moderately fine-	Friable.
Oahe-------	Outwash-----------	Outwash plains-	Nearly level-	Good to moderate.	Medium to coarse.	Friable.
Orman------	Local alluvium-----	Colluvial slopes.	Level--------	Good to moderate.	Fine------------	Very firm.
Promise----	Shaly till---------	Uplands--------	Sloping------	Good--------	Fine------------	Firm.
Raber------	Glacial till-------	Uplands--------	Undulating---	Good--------	Moderately fine-	Friable.
Sioux------	Alluvium and outwash.	Outwash plains-	Level to undulating.	Good to excessive.	Medium and coarse.	Friable.
Spottswood-	Alluvium and outwash.	Outwash plains-	Level--------	Moderate to imperfect.	Medium and coarse.	Friable.
Tetonka----	Local alluvium-----	Upland depression.	Level--------	Imperfect to poor.	Moderately fine-	Friable to firm.
Wessington-	Alluvium and outwash.	Outwash plains-	Level to undulating.	Good--------	Medium and coarse.	Friable.
Williams---	Glacial till-------	Uplands--------	Undulating---	Good--------	Medium----------	Friable.
Zahl-------	Glacial till-------	Uplands--------	Hilly--------	Excessive---	Medium----------	Friable.

6/2, dry; 4/2-4/3, moist) when crushed; colors vary from place to place within the layer; hard; weak, medium, prismatic and weak, very fine, subangular blocky to granular structure; very thin, discontinuous coatings on the peds; clear, smooth boundary.

B31 20 to 24 inches, light brownish-gray to dark olive-brown (2.5Y-5Y 6/2, dry; 4/3, moist) silt loam; pale brown to grayish brown (2.5Y-5Y 6/3, dry; 5/2, moist) when crushed; hard; very weak, medium, prismatic structure; very thin, discontinuous coatings on the prism faces; violent effervescence with acid; few carbonate segregations; clear, smooth boundary.

B3ca 24 to 33 inches, light brownish-gray to grayish-brown (2.5Y-5Y 6/2, dry; 4/3, moist) silt loam; pale olive to olive (5Y 6/3, dry; 5/3, moist) when crushed; hard; very weak, medium, prismatic structure to massive; violent effervescence with acid; common carbonate segregations; clear, smooth boundary.

B33 33 to 38 inches, pale-olive and light olive-gray to olive (5Y 6/4, 6/2, dry; 4/3, moist) silt loam; light olive gray to very dark grayish brown (5Y 6/2, dry; 10YR 3/2, moist) when crushed; massive; violent effervescence with acid; few carbonate segregations; this horizon is the basal part of the loess mantle; clear, smooth boundary.

B34-D1 38 to 42 inches, gray, light brownish-gray, and pale-brown to grayish-brown (10YR 6/1, 6/2, 6/3, dry; 5/2, moist) clay loam; light brownish gray to dark grayish brown (10YR 6/2, dry; 4/2, moist) when crushed; massive; violent effervescence with acid; many carbonate segregations; clear, smooth boundary.

D2 42 to 49 inches, gray, light brownish-gray, and pale-brown to dark grayish-brown (10YR 6/1, 6/2, 6/3, dry; 4/2, moist) loam; light brownish gray to dark grayish brown (10YR 6/2, dry; 4/2, moist) when crushed; slightly hard; massive; violent effervescence with acid; few carbonate segregations; material appears to be alluvium; abrupt, smooth boundary.

D3 49 to 55 inches, grayish-brown and brownish-yellow to dark grayish-brown (10YR 5/2, 6/6, dry; 4/2, moist) fine clay loam; light brownish gray to dark grayish brown (10YR 6/2, dry; 4/2, moist) when crushed; few, fine, indistinct, strong-brown (7.5YR 5/8) mottles; very hard; weak, fine, prismatic structure; thin, continuous coatings; violent effervescence with acid; material appears to be alluvium; clear, smooth boundary.

D4 55 to 62 inches, gray, light brownish-gray, and pale-brown to dark grayish-brown (10YR 6/1, 6/2, 6/3, dry; 4/2, moist) clay loam that appears to be glacial till; light brownish gray to dark grayish brown (10YR 6/2, dry; 4/2, moist) when crushed; few, fine, indistinct, strong-brown (7.5YR 5/8) mottles; massive; violent effervescence with acid.

The dark-colored A horizon is silt loam or loam. It is 2 or 3 inches thick on well-drained tops of hills and 6 to 8 inches thick in nearly level areas. In well-drained sites, the upper part of the B horizon is silty clay loam that grades to silt loam with increasing depth. In moderately well drained sites, however, the upper part is silt loam, the middle part is silty clay loam, and the lower part is silt loam. The layers of silty clay loam have the strongest prismatic structure.

BONILLA SERIES

The Bonilla series consists of medium-textured soils that are moderately well drained. These soils belong to the Chernozem great soil group. They occur in nearly level areas and small drainageways of uplands underlain by Mankato till. The soils in the nearly level areas have formed from loam till, and those in the drainageways, from local alluvium.

A profile 0.3 mile east and 85 feet north of the SW cor. of sec. 7, T. 115 N., R. 69 W., is as follows:

Ap 0 to 6 inches, dark-gray to very dark brown (10YR 4/1, dry; 2/2, moist) silt loam or loam; dark gray to very dark gray (10YR 4/1, dry; 3/1, moist) when crushed; loose; very weak, very fine, granular structure; abrupt, smooth boundary.

A3-B1 6 to 16 inches, dark grayish-brown to very dark grayish-brown (10YR 4/2, dry; 3/2, moist) loam or clay loam; dark grayish brown to very dark grayish brown (10YR 4/2, dry; 3/2, moist) when crushed; hard; weak, fine, prismatic and very weak, very fine, granular structure; very thin, discontinuous coatings on the peds; clear, smooth boundary.

B21 16 to 23 inches, dark grayish-brown to very dark grayish-brown (10YR 4/2, dry; 2.5Y 3/2, moist) clay loam; dark grayish brown (2.5Y 4/2, dry or moist) when crushed; hard; moderate, fine, prismatic and moderate, very fine, subangular blocky structure; moderately thin, continuous coatings on the peds; clear, smooth boundary.

B22 23 to 27 inches, grayish-brown to dark grayish-brown (2.5Y 5/2, dry; 4/2, moist) coarse clay loam; same color when crushed; hard; moderately weak, fine, prismatic and moderately weak, very fine, subangular blocky structure; thin, continuous coatings; clear, smooth boundary.

B31 27 to 34 inches, coarse clay loam that is light brownish gray to dark grayish brown (2.5Y-5Y 6/2, dry; 2.5Y 4/2, moist) when crushed; hard; weak, fine, prismatic structure with thin, continuous coatings on the vertical faces; strong effervescence with acid; few carbonate segregations; few salt crystals; clear, smooth boundary.

B3-Cca 34 to 43 inches, light brownish-gray, light-gray, and pale-yellow to grayish-brown (2.5Y 6/2, 7/2, 7/4, dry; 5/2, moist) coarse clay loam; light gray to grayish brown (5Y-2.5Y 7/2, dry; 2.5Y 5/2, moist) when crushed; slightly hard; very weak, fine, prismatic structure with thin, discontinuous coatings on the vertical faces; strong effervescence with acid; common carbonate segregations; few, soft

crystalline masses of salt; clear, smooth boundary.

C1 43 to 50 inches, light brownish-gray and light-gray to grayish-brown (2.5Y 6/2, 7/2, dry; 5/2, moist) coarse clay loam; light gray to grayish brown (2.5Y 7/2, dry; 5/2, moist) when crushed; massive; strong effervescence with acid; few carbonate segregations; clear, smooth boundary.

C2 50 to 60 inches, light brownish-gray to grayish-brown (2.5Y 6/2, dry; 5/2-4/2, moist) clay loam; massive; strong effervescence with acid; few carbonate segregations.

The surface layer generally consists of silt loam but is loam in places. In most areas the B horizons are clay loam or silty clay loam, but, in a few drainageways, the texture of the entire profile is loam. The profiles that have a loam texture are generally stratified and contain dark-colored former surface layers in the B and C horizons. Most areas of Bonilla soils contain a soil that has a thin, hard, dark-colored layer with subangular blocky structure in the lower B horizons. Apparently, this soil is a variant that once was a solodized-Solonetz soil.

CAVOUR SERIES

The soils of the Cavour series are deep, but a claypan below the plow layer limits the penetration of water and the development of plant roots. These soils belong to the solodized-Solonetz great soil group. Their parent material is medium to moderately fine textured till, drift, loess, or local alluvium, or a combination of these materials. The soils range from well drained to poorly drained, but in most areas they are moderately well drained. They occur in uplands in all parts of the county.

A profile 175 feet north and 330 feet west of the SE cor. of SW1/4SE1/4 sec. 34, T. 110N., R. 70 W., is as follows:

Ap 0 to 6 inches, dark grayish-brown to very dark brown (10YR 4/2, dry; 2/2, moist) silt loam; dark grayish brown to very dark grayish brown (10YR 4/2-4/1, dry; 3/2, moist) when crushed; slightly hard; clods that break to very weak, very fine, granular structure; abrupt, smooth boundary.

A2 6 to 11 inches, gray to very dark grayish-brown (10YR 5/1-4/1, dry; 3/2, moist) silt loam; grayish brown to very dark grayish brown (10YR 5/2, dry; 3/2, moist) when crushed; some white flecks on the peds; slightly hard; very weak, fine, granular and very weak, medium, prismatic structure; abrupt, smooth boundary.

B21 11 to 18 inches, very dark grayish-brown (2.5Y-10YR 3/2-3/2, dry) to very dark grayish-brown (2.5Y-10YR 3/2, moist) fine silty clay loam; grayish brown to very dark grayish brown (2.5Y-10YR 5/2, dry; 3/2, moist) when crushed; very hard, moderate, fine, columnar and moderately weak, fine, subangular blocky structure; moderately thin, continuous coatings on the blocky peds; the upper part of the layer is a transitional zone from the A2 horizon above; clear, smooth lower boundary.

B22 18 to 26 inches, dark-gray to very dark gray (10YR 4/1, dry; 3/1, moist) fine silty clay loam; same color when crushed; very hard; weak, medium, columnar and moderately weak, fine, subangular blocky structure; thin, continuous coatings; few lime segregations in the noncalcareous matrix; clear, smooth boundary.

B31 26 to 33 inches, dark grayish-brown to very dark grayish-brown (10YR 4/2, dry; 3/2, moist) silty clay loam; grayish brown to dark gray (10YR 5/2, dry; 4/1-4/2, moist) when crushed; very weak, medium, columnar and very weak, fine, subangular blocky structure; thin, discontinuous coatings on the blocky peds; strong effervescence with acid; few, small carbonate concretions; clear, smooth boundary.

B3ca 33 to 40 inches, light brownish-gray to grayish-brown (2.5Y 6/2, dry; 5/2, moist) clay loam; light brownish gray to dark grayish brown (2.5Y 6/2, dry; 10YR 4/2, moist) when crushed; very weak, medium, columnar and very weak, fine, subangular blocky structure; thin, discontinuous coatings; violent effervescence with acid; many carbonate segregations and few carbonate concretions; clear, smooth boundary.

B33 40 to 48 inches, light brownish-gray to dark grayish-brown (2.5Y-10YR 6/2, dry; 4/2-5/2, moist) clay loam; light brownish gray to dark grayish brown (10YR 6/2, dry; 4/2, moist) when crushed; very weak, medium, columnar and very weak, fine, subangular blocky structure; discontinuous coatings; violent effervescence with acid; few carbonate segregations; clear, smooth boundary.

C1 48 to 54 inches, grayish-brown to dark grayish-brown (10YR 5/2, dry; 4/2, moist) loam; few, fine, distinct, brownish-yellow (10YR 6/8) mottles; soil material tends to be laminated; violent effervescence with acid; few carbonate segregations; clear, smooth boundary.

C2 54 to 62 inches, light brownish-gray to dark grayish-brown (10YR 6/2, dry; 4/2, moist) coarse clay loam; massive; violent effervescence with acid; few carbonate segregations.

The profile is brownish in well-drained areas and grayish or olive in moister sites. The surface layer consists of loam or silt loam, and the B2 horizon, of silty clay loam or clay loam. The lower horizons consist of medium or moderately fine textured material.

CRESBARD SERIES

The soils of the Cresbard series are medium textured, and they have a moderately compact claypan, 8 to 20 inches below the surface. These soils belong to the solodized-Solonetz great soil group. They are moderately well drained and occur mainly in drainageways or in nearly level parts of the uplands. The parent material is medium to moderately fine textured till, drift, loess, local alluvium, or a combination of these materials.

A profile 0.3 mile north and 775 feet east of the SW cor. of sec. 8, T. 115N., R. 69 W., is as follows:

Ap 0 to 7 inches, dark-gray to very dark gray (10YR 4/1, dry; 3/1, moist) silt loam or loam; same color when crushed; slightly hard; clods break to weak, very fine, granular structure; abrupt, smooth boundary.

A2 7 to 16 inches, dark-gray to very dark gray (10YR 4/1-4/2, dry; 3/1, moist) silt loam; same color when crushed; some white and gray flecks on peds; weak, medium, prismatic and weak, very fine, prismatic structure and also very weak, very fine, subangular blocky to granular structure; clear, smooth boundary.

B21 16 to 26 inches, very dark gray (10YR 3/1-4/1, dry; 3/1-3/0, moist) fine silty clay loam; dark gray to very dark gray (10YR 4/1, dry; 3/1, moist) when crushed; extremely hard; moderate, fine, prismatic and moderate, very fine, subangular blocky structure; coatings on peds are thin in the upper part of the horizon and become thicker with increasing depth; the coatings are thicker on the lower surface of a ped than on the upper surface of the underlying ped; clear, smooth boundary.

B22 26 to 30 inches, dark-gray and dark grayish-brown to very dark gray and very dark grayish-brown (10YR 4/1, 4/2, dry; 3/1, 3/2, moist) fine silty clay loam; gray to very dark gray (10YR 5/1-4/1, dry; 3/1, moist) when crushed; extremely hard; moderate, fine, prismatic and moderately weak, very fine, subangular blocky structure; thin, continuous coatings on the peds; clear, smooth boundary.

B31 30 to 35 inches, light brownish-gray and light yellowish-brown to grayish-brown (2.5Y 6/2, 6/4, dry; 5/2, moist) silty clay loam with few, fine, faint, yellowish-brown (10YR 6/6) mottles; hard; weak, fine, prismatic and weak, very fine, subangular blocky structure; thin, discontinuous coatings on the peds; strong effervescence with acid; clear, smooth boundary.

B3ca 35 to 45 inches, light brownish-gray, gray, and light yellowish-brown to grayish-brown, gray, and light olive-brown (2.5Y 6/2, 6/1, 6/4, dry; 5/2, 5/1, 5/4, moist) coarse silty clay loam; pale olive to grayish brown (5Y 6/3, dry; 2.5Y 5/2-5/4, moist) when crushed; few, fine, indistinct, brownish-yellow (10YR 6/6) mottles; slightly hard; very weak, medium, prismatic and very weak, very fine, subangular blocky structure; violent effervescence with acid; few carbonate segregations; clear, smooth boundary.

C1 45 to 53 inches, pale-olive and gray to grayish-brown, gray, and light olive-brown (5Y 6/3, 6/1, dry; 2.5Y 5/2, 5/1, 5/4, moist) coarse clay loam; pale olive to grayish brown (5Y 6/3, dry; 2.5Y 5/2-5/4, moist) when crushed; massive; violent effervescence with acid; few carbonate segregations but these are less conspicuous than those in the horizon above; clear, smooth boundary.

C2 53 to 61 inches, light olive-gray, gray, and pale-olive to olive, olive-gray, and gray (5Y 6/2, 6/1, 6/3, dry; 5Y 5/3, 5/2, 5/1, moist) loam; pale olive to olive brown (5Y 6/3-6/2, dry; 2.5Y 4/3, moist) when crushed; massive; violent effervescence with acid; few carbonate segregations.

The texture of the Cresbard soils ranges from loam to silt loam in the A horizon, from clay loam to silty clay loam in the B horizon, and from loam to silty clay loam or clay loam in the C horizon. The surface layer is generally dark gray when dry, but it may be dark grayish brown on well-drained, gentle slopes. The A1 and A2 horizons have prismatic structure, particularly if the claypan is at a depth of 16 to 20 inches. Many of the prisms are composed of very weak, thin plates that extend horizontally more or less continuously through the prisms. Buried surface layers occur in the B and C horizons in some areas.

EAKIN SERIES

The soils of the Eakin series are well drained, deep, and medium textured. These soils belong to the Chestnut great soil group. They have formed from loess-mantled till in the southern and northwestern parts of the county. The loess is less than 30 inches thick, and it was of silt loam texture before the soils developed. In the northwestern corner of the county, some of the loess contains much very fine sand. The glacial till is generally of clay loam texture, but it is loam in a few areas. In some places a thin, stratified sandy or clayey layer occurs just under the loess.

A profile (see table 13 for laboratory data) 370 feet south and 90 feet west of the NE cor. of sec. 15, T. 109 N., R. 69 W., is as follows:

A1 0 to 4 inches, very dark gray to very dark grayish-brown (10YR 3/1.5, dry) silt loam with very dark grayish-brown (10YR 3/2, dry) coatings; very dark brown (10YR 2/2, moist) with black to very dark brown (10YR 2/1.5, moist) coatings; soft when dry, very friable when moist; weak, fine, granular and crumb structure; quartz grains are predominantly dark, but some are fine and clear; clear, smooth boundary.

B21 4 to 8 inches, dark grayish-brown (10YR 4/2, dry) silty clay loam with very dark grayish-brown to grayish-brown (10YR 3.5/2, dry) coatings; very dark brown to very dark grayish brown (10YR 2.5/2, moist) with black to very dark brown (10YR 2/1.5, moist) coatings; slightly hard when dry, friable when moist; weak to moderate, medium, prismatic structure that breaks to fine, prismatic structure that, in turn, breaks to moderate, medium and fine, subangular blocky structure; thin, discontinuous coatings on the peds; quartz grains are predominantly dark but some are fine, and clear; clear, smooth boundary.

B22 8 to 14 inches, dark grayish-brown (10YR 4/2, dry) silty clay loam with very dark grayish-brown to dark grayish-brown (10YR 3.5/2, dry) coatings; very dark grayish brown to dark grayish brown (10YR 3.5/2, moist) with black

to very dark brown (10YR 2/1.5, moist) coatings; slightly hard when dry, friable to firm when moist; moderate, medium and fine, subangular blocky structure; thin, continuous and moderate, discontinuous coatings on peds; few, fine, clear quartz grains; clear, smooth boundary.

B2ca 14 to 19 inches, grayish-brown to light brownish-gray (2.5Y 5.5/2, dry) silt loam with few, fine, yellowish-brown (10YR 5/8, dry) mottles and grayish-brown (2.5Y 5/2, dry) coatings; olive brown to light olive brown (2.5Y 4.5/3, moist) with few, fine, prominent dark yellowish-brown (10YR 4/4, moist) mottles and with olive-brown (2.5Y 4/3, moist) coatings; slightly hard to hard when dry, friable to firm when moist; weak to moderate, coarse, prismatic structure that breaks to weak, coarse and medium, blocky structure; weakly to moderately calcareous; common, medium and small, soft carbonate segregations; thin, continuous and moderate, discontinuous coatings on the primary structural peds; few, fine, clear quartz grains; clear, smooth boundary.

B3ca 19 to 26 inches, light olive-brown (2.5Y 5/3, dry) silt loam with few, fine, prominent, yellowish-brown (10YR 5/8, dry) mottles; olive brown (2.5Y 4/4, moist) with few, fine, prominent, dark yellowish-brown (10YR 4/4, moist) mottles; slightly hard to hard when dry, friable to firm when moist; weakly to moderately calcareous; weak to moderate, coarse, prismatic structure that breaks to medium, prismatic structure that, in turn, breaks to weak, coarse and medium, blocky structure; few to common, medium and small, soft carbonate segregations; thin, discontinuous coatings on the vertical faces and thin, very discontinuous coatings on the horizontal faces of the primary structural peds; few, fine, clear quartz grains; clear, irregular boundary.

D-B3ca 26 to 35 inches, weakly to moderately calcareous clay loam; no matrix color but many, fine and medium, distinct, olive-brown and light brownish-gray (2.5Y 4/4 and 6/2, dry) mottles and few, medium, prominent, yellowish-brown (10YR 5/8, dry) mottles; grayish-brown (2.5Y 5/2, dry) coatings; olive-brown and grayish-brown (2.5Y 3/4 and 5/2, moist) mottles and dark yellowish-brown (10YR 4/4, moist) and olive-brown (2.5Y 4/2.5, moist) coatings; hard when dry, friable to firm when moist; coarse, prismatic structure that breaks to medium, prismatic structure; common to many, medium and small, soft carbonate segregations and few to common, medium and small, hard carbonate concretions; weak to moderate, thin, discontinuous coatings on the vertical faces of the prisms; quartz grains are predominantly dark but a few are clear; clear, irregular boundary.

D-B3ca 35 to 42 inches, light yellowish-brown (2.5Y 6/3, dry) clay loam with common, fine, distinct, yellowish-brown (10YR 5/8, dry) mottles and common, very fine, distinct, very dark gray (10YR 3/1, dry) mottles; light olive brown (2.5Y 5/3, moist) with mottles of dark yellowish brown (10YR 4/4, moist) and black (10YR 2/1, moist); hard when dry, friable to firm when moist; weakly to moderately calcareous; weak, coarse, prismatic structure that breaks to medium, prismatic structure; few, medium and small, soft carbonate segregations and few, medium and small, hard carbonate concretions; thin, very discontinuous coatings on the vertical faces of the primary structural peds; few, fine, clear quartz grains; clear, irregular boundary.

Dca 42 to 60 inches, grayish-brown (2.5Y 5/2, dry) clay loam with common, fine, faint, pale-yellow and gray to light-gray (2.5Y 7/4 and N 6/0, dry) mottles and few, fine, prominent, yellowish-brown (10YR 5/8, dry) mottles; dark grayish brown (2.5Y 4/2, moist) with light olive-brown and gray (2.5Y 5/4 and N 5/0, moist) mottles and yellowish-red (5YR 5/8, moist) mottles; very hard when dry, friable to firm when moist; massive (structureless) to weak to moderate, fine and medium, blocky structure; weakly to moderately calcareous; few to common, medium and soft, small carbonate segregations and few, medium and small, hard carbonate concretions; thin, very discontinuous coatings on the horizontal surfaces of the structural units; quartz grains predominantly are dark, but a few are fine and clear.

The A horizon is 3 to 6 inches thick and is silt loam or loam. Depending on the depth to till, the B horizon may be silty clay loam in the upper part and silt loam or clay loam in the lower part. Generally, the lower B horizon, like the C or D horizon, has formed from a clay loam till.

EXLINE SERIES

The soils of the Exline series are deep, but they have a claypan within 1 to 4 inches of the surface. These soils belong to the solodized-Solonetz great soil group. They are moderately well drained to poorly drained soils that formed in alluvial material. They are on terraces along streams and on coalesced fans adjacent to hilly areas. Most areas are not flooded, but the soils are wet following heavy rainfall.

Two soil types of the Exline series--Exline silty clay loam and Exline silty clay--occur in Hand County.

A profile of Exline silty clay loam 60 feet north and 330 feet west of the SE cor. of the SW1/4SE1/4 sec. 22, T. 116 N., R. 67 W., is as follows:

A1-A2 0 to 2 inches, dark-gray to very dark gray (10YR 4/1, dry; 10YR 3/1, moist), friable loam; very dark grayish brown to very dark gray (10YR 3/2-3/1, moist) when crushed; very weak, very thin or fine, platy to granular structure; many, very fine, clear quartz grains; abrupt, smooth boundary.

B2 2 to 5 inches, dark-gray and gray (2.5Y-10YR 4/1, 5/1, dry) or dark grayish-brown and very dark gray (2.5Y 4/2 and 10YR 3/1, moist)

silty clay loam; dark gray (10YR 4/1-5/1, dry) to very dark gray (10YR 3/1, moist) when crushed; very hard; moderately weak, fine, columnar structure and very weak, very fine, subangular blocky to granular structure; very thin, continuous coatings that also cover a few of the fine, clear quartz grains; very slight effervescence with acid; no visible salts detected in this or the lower horizons; clear, smooth boundary.

B31 5 to 13 inches, gray to very dark gray and dark grayish-brown (10YR 5/1, dry; 10YR 4/1, 4/2, moist) loam; gray to dark grayish brown (10YR 5/1, dry; 2.5Y 4/2-4/1, moist) when crushed; very hard; very weak, medium, columnar structure with very thin, discontinuous coatings on the vertical faces; violent effervescence with acid; clear, smooth boundary.

B32 13 to 19 inches, grayish-brown and gray (10YR 5/2, 5/1, dry) to dark grayish-brown and dark-gray (10YR 4/2, 4/1, moist) coarse clay loam; gray to dark grayish brown (10YR 5/1-5/2, dry; 2.5Y 4/2, moist) when crushed; hard; very weak, medium, columnar structure with very thin, discontinuous coatings on the vertical faces; violent effervescence with acid; clear, smooth boundary.

B33 19 to 26 inches, light brownish-gray to grayish-brown (2.5Y 6/2, dry; 2.5Y 5/2-6/2, moist) coarse silty clay loam; light brownish gray to very dark grayish brown (2.5Y 6/2, dry; 10YR 3/2, moist) when crushed; hard; very weak, medium, columnar structure with very thin, discontinuous coatings on the vertical faces; violent effervescence with acid; clear, smooth boundary.

B34-A1b 26 to 32 inches, light brownish-gray to grayish-brown (2.5Y 6/2, dry; 5/2, moist) coarse clay loam; light brownish gray to dark grayish brown (2.5Y 6/2, dry; 10YR 4/2, moist) when crushed; slightly hard; moderately weak, medium, columnar and moderately weak, fine, subangular blocky structure; blocky peds have thin, continuous coatings; violent effervescence with acid; common carbonate segregations; clear, smooth boundary.

B3ca 32 to 40 inches, light brownish-gray to grayish-brown (2.5Y 6/2, dry; 5/2, moist) coarse clay loam; similar colors when crushed; slightly hard; moderately weak, medium, columnar structure with thin, discontinuous coatings on the vertical faces; violent effervescence with acid; many carbonate segregations that are almost continuous throughout the mass; clear, smooth boundary.

C-D 40 to 44 inches, loam that is gray to dark grayish brown (10YR 6/1-6/2, dry; 4/2, moist) when crushed; massive; violent effervescence with acid; many carbonate segregations but less than in above horizon; abrupt, smooth boundary.

D1 44 to 55 inches, loose sand that is gray, light brownish gray, and pale brown (10YR 6/1, 6/2, 6/3, dry) to dark grayish brown, grayish brown, and brown (10YR 4/2, 5/2, 5/3, moist); colors are mainly those of individual sand grains; violent effervescence with acid; few carbonate segregations; clear, smooth boundary.

D2 55 to 65 inches, loose loamy sand or sandy loam that is gray and grayish brown to dark grayish brown and dark gray (10YR 5/1, 5/2, dry; 4/2, 4/1, moist); these are the basic colors of the sand grains; violent effervescence with acid; few carbonate segregations.

Exline silty clay loam has a thin surface layer of silt loam or silty clay loam. The average texture of the plow layer, after the surface soil and claypan have been mixed, is silty clay loam. In most areas the B2 horizon of this soil is moderately fine textured, but, in a few places, it consists of loam or silty clay. The lower part of the B horizon and the entire C horizon generally are medium textured to moderately fine textured and are moderately to strongly alkaline. The D horizon is also moderately to strongly alkaline. In some areas in the northeastern part of the county, Exline silty clay loam is underlain by gravel. Areas of this soil on alluvial fans have a glacial till substratum.

Exline silty clay is similar to Exline silty clay loam but is not as extensive. Its B horizon consists of silty clay or clay, and its C, of silty clay or silty clay loam. In most areas of Exline silty clay, the B horizon appears to be less saline than that of Exline silty clay loam.

GANN SERIES

The Gann series consists of medium-textured, deep, well-drained soils. These soils belong to the Chestnut great soil group. They consist of local alluvium that was deposited on gentle slopes. The alluvium was washed from adjacent sloping soils formed from glacial till. It is loam nearest the adjacent soils but may grade to silty clay loam at a greater distance. In a few areas in the southwestern corner of the county, the parent material of these soils is silty clay loam.

A profile 50 feet east and 0.15 mile north of the SW cor. of sec. 20, T. 116 N., R. 70 W., is as follows:

Ap 0 to 6 inches, very dark gray to black (10YR 3/1-3/2, dry; 2/1, moist) coarse silt loam; dark gray to black (10YR 4/1, dry; 2/1, moist) when crushed; slightly hard; very weak, very fine, granular structure to cloddy; abrupt, smooth boundary.

B11 6 to 15 inches, dark grayish-brown to black (10YR-2.5Y 4/2, dry; 2/1, moist) loam or silt loam; grayish brown to very dark grayish brown (2.5Y-10YR 5/2, dry; 10YR 3/2, moist) when crushed; slightly hard; very weak, medium, prismatic and very weak, very fine, granular structure; very thin, discontinuous coatings on horizontal faces of peds and thin, discontinuous coatings on the vertical faces; clear, smooth boundary.

B12 15 to 20 inches, grayish-brown to very dark grayish-brown (2.5Y 5/2, dry; 3/2-4/2, moist) loam or silt loam; grayish brown to dark

grayish brown (2.5Y 5/2, dry; 4/2, moist) when crushed; slightly hard; weak, medium, prismatic structure and very weak, very fine, granular to subangular blocky structure; very thin, discontinuous coatings on the prism faces; clear, smooth boundary.

B2 20 to 24 inches, grayish-brown to dark grayish-brown (2.5Y 5/2, dry; 4/2, moist) loam or silt loam; same color when crushed; hard; moderately weak, medium, prismatic and very weak, very fine, subangular blocky structure; thin, discontinuous coatings; few carbonate segregations in the noncalcareous matrix; clear, smooth boundary.

B2ca 24 to 30 inches, grayish-brown to dark grayish-brown (2.5Y 5/2, dry; 4/2, moist) loam to silt loam; light brownish gray to very dark grayish brown (2.5Y 6/2-5/2, dry; 10YR 3/2, moist) when crushed; hard; weak, medium, prismatic and very weak, very fine, subangular blocky structure; very thin, discontinuous coatings on the prisms; violent effervescence with acid; common carbonate segregations; few salt crystals; clear, smooth boundary.

B31 30 to 45 inches, light brownish-gray to dark grayish-brown (10YR 6/2, dry; 4/2, moist) coarse loam; grayish brown to dark grayish brown (10YR 5/2, dry; 4/2, moist) when crushed; slightly hard; very weak, medium, irregular, prismatic structure; violent effervescence with acid; few carbonate segregations; very few salt crystals; clear, smooth boundary.

B32 45 to 53 inches, light brownish-gray to dark grayish-brown (10YR 6/2, dry; 4/2, moist) silt loam or loam; same color when crushed; slightly hard; weak, medium, prismatic structure; very thin, discontinuous coatings; violent effervescence with acid; few carbonate segregations and a concentration of soft segregations at a depth between 48 and 49 inches; very few salt crystals; clear, smooth boundary.

B3-C 53 to 63 inches, light brownish-gray to dark grayish-brown (10YR 6/2, dry; 4/2, moist) loam to silt loam; same color when crushed; slightly hard; weak, medium, prismatic structure; violent effervescence with acid; few carbonate segregations and salt crystals.

The profile normally consists of silt loam, but the texture ranges from loam to silty clay loam. The dark-colored surface layer is thick where alluvium has accumulated slowly over a long period, but it is thin where alluvium has been deposited recently at a rapid rate.

In many places the Gann soils have buried, dark-colored layers that once were at the surface. These layers are separated by lighter colored layers, which generally have a different texture.

In some places the alluvium in the subsoil and the substratum contains layers of sand. In other places the substratum is made up of glacial till.

HAMERLY SERIES

The Hamerly series is made up of deep, moderately well drained to somewhat poorly drained soils that have formed in glacial till of loam texture. These soils belong to the Solonchak great soil group. They occur around the edges of large depressions and on low knolls between depressions. The areas frequently have a high water table. The Hamerly soils are inextensive in Hand County, and most areas are too small to be shown separately on the detailed map.

A profile 330 feet south and 250 feet west of the E. 1/4 cor. of sec. 12, T. 116 N., R. 66 W., is as follows:

Ap 0 to 6 inches, dark-gray to very dark gray (10YR 4/1, dry; 3/1, moist) loam; soft; very weak, fine, granular structure; abrupt, smooth boundary.

AB 6 to 9 inches, grayish-brown to dark grayish-brown (10YR 5/2, dry; 4/2, moist) loam; soft; very weak, fine, granular and very weak, medium, prismatic structure; strong effervescence with acid; clear, smooth boundary.

Cca 9 to 24 inches, light yellowish-brown to light olive-brown (2.5Y 6/4, dry; 5/4-5/2, moist) loam; slightly hard; very weak, fine, granular to subangular blocky structure; common carbonate segregations; few, fine, faint, yellowish-brown (10YR 5/6) mottles; violent effervescence with acid; clear, smooth boundary.

C 24 to 60 inches, light olive-brown to olive-brown (2.5Y 5/4, dry; 4/4, moist) loam glacial till; very hard when dry; massive (structureless) to very weak, irregular, blocky structure; strong effervescence with acid; few gypsum crystals.

The surface layer generally is calcareous and dark colored. In most areas the light-gray, very calcareous subsoil is within plow depth. Normally, the B horizon is lacking in these soils; but it is weakly developed in some areas where the water table is lower than usual. The B and C horizons are slightly saline.

HAND SERIES

The Hand series consists of nearly level to gently undulating, well drained to moderately well drained soils that have developed in stratified loamy glacial outwash. The soils belong to the Chernozem great soil group. Their texture is normally loam or silt loam, but in some places it is very fine sandy loam, sandy loam, or loamy sand. The outwash, which is 60 to 100 inches thick, is underlain by slowly permeable glacial till of loam texture. In some places there are a few pebbles in the solum.

A profile (see laboratory data in table 13) 0.15 mile north and 40 feet east of the SW cor. of sec. 2, T. 114 N., R. 66 W., is as follows:

Ap 0 to 6 inches, dark grayish-brown to very dark gray (10YR 4/1-4/2, dry; 3/1, moist) coarse loam; slightly hard clods that break to weak, fine granules; abrupt, smooth boundary.

B 6 to 20 inches, dark grayish-brown to very dark grayish-brown (10YR 4/2, dry; 3/2, moist) loam; slightly hard; weak, coarse to

medium prisms and very weak, fine granules; clear, smooth boundary.

Cca 20 to 33 inches, light brownish-gray to very dark grayish-brown (2.5Y 6/2-6/3, dry; 3/2, moist) coarse silt loam; few, fine, white carbonate segregations and yellowish-brown (10YR 5/4) mottles; soft; weak granules; violent effervescence with acid; clear, smooth boundary.

C2-C3 33 to 82 inches, pale-yellow to light olive-brown (2.5Y 7/4, dry; 5/6, moist) coarse silt loam; few, fine, olive-yellow (2.5Y 6/6-5/6) mottles; soft; moderately defined, medium plates formed from laminated parent material; strong effervescence with acid; clear, smooth boundary.

C4 82 to 114 inches, pale-yellow to light olive-brown (2.5Y 7/4, dry; 5/4, moist) silt loam; few to common, fine and medium, strong-brown to dark-brown (7.5YR 5/6, dry; 4/4, moist) mottles; soft; moderately defined, medium plates formed from laminated parent material; strong effervescence with acid; common gypsum crystals.

The surface layer ranges from loam to silt loam in texture and from 6 to 8 inches in thickness. The texture of the B horizon generally is loam, but it may be silt loam, silty clay loam, or clay loam. The B horizon is 14 to 24 inches thick. The upper part of the profile is nonsaline, but the till substratum is saline.

HARRIET SERIES

The Harriet series consists of deep, somewhat poorly drained to poorly drained soils that have a claypan at or near the surface. These are solodized-Solonetz soils that occur in the area of Chestnut soils. They are made up of alluvium deposited by streams on low terraces. The texture of the alluvium ranges from loam to coarse silty clay, but it normally is silty clay loam. In areas where there is channel fill, strata of sand and gravel may occur in the lower part of the subsoil and in the substratum. Normally, the soils are not flooded by streams, but they may be flooded by runoff from slopes along the valleys.

A profile 48 feet south and 333 feet east of Elm Creek at the north side of the NW1/4 sec. 8, T. 110 N., R. 70 W., is as follows:

A2 0 to 1/4 inch, light-gray (10YR 7/1, dry), friable to loose silt loam with many very fine, clear quartz grains; the mass ranges from structureless to slightly vesicular; abrupt, smooth boundary.

B21 1/4 to 4 inches, dark-gray to very dark gray (10YR-2.5Y 4/1, dry; 3/1, moist), dispersed silty clay (or silty clay loam); gray to very dark gray (10YR-2.5Y 5/1, dry; 3/1-3/2, moist) when crushed; very hard; very weak, irregular, medium, columnar and weak, very fine, subangular blocky structure; clear quartz grains; the blocky peds have thin, discontinuous coatings that cover some of the grains; clear, smooth boundary.

B22 4 to 8 inches, dark-gray to very dark grayish-brown (10YR-2.5Y 4/1, dry; 2.5Y 3/2, moist), dispersed silty clay or fine silty clay loam; light brownish gray to very dark grayish brown (2.5Y 6/2-6/1, dry; 3/2, moist) when crushed; contains disseminated carbonates and is very slightly calcareous; very hard; very weak, irregular, medium, columnar and weak, very fine, subangular blocky structure; few, clear quartz grains; the blocky peds have very thin, discontinuous coatings that cover some of the grains; clear, smooth boundary.

B3ca 8 to 18 inches, grayish-brown to dark grayish-brown (2.5Y 5/2, dry; 4/2, moist) silty clay or silty clay loam; grayish brown to dark grayish brown (2.5Y 5/2-6/2, dry; 4/2, moist) when crushed; very hard; very weak, irregular, medium, columnar and weak, very fine, subangular blocky structure; few, clear quartz grains; very thin, discontinuous coatings that cover some of the grains; violent effervescence with acid because of the disseminated carbonates and many carbonate segregations; common crystalline masses of salt; clear, smooth boundary.

B3 18 to 25 inches, dark-gray to dark grayish-brown (10YR-2.5Y 4/1-5/2, dry; 2.5Y 4/2-4/1, moist) silty clay or silty clay loam; dark gray to dark grayish brown (2.5Y-10YR 4/1, dry; 4/2-4/1, moist) when crushed; very weak, irregular, medium, columnar and weak, very fine, subangular blocky structure; few, clear quartz grains; thin, discontinuous coatings cover some of the grains; slight to no effervescence with acid in the matrix but the common carbonate segregations are effervescent; common crystalline masses of salt (gypsum); clear, smooth boundary.

C1 25 to 35 inches, grayish-brown to dark grayish-brown (2.5Y 5/2, dry; 2.5Y 4/2, moist) silty clay or silty clay loam; light brownish gray to dark grayish brown (2.5Y 6/2, dry; 2.5Y-10YR 4/2-4/1, moist) when crushed; very weak, medium, columnar and very weak, very fine, subangular blocky structure; few, clear quartz grains; very thin, discontinuous coatings cover some of the grains; violent effervescence with acid; common carbonate segregations; many crystalline masses of salt; clear, smooth boundary.

C-D1 35 to 43 inches, fine clay loam that is light brownish gray to dark grayish brown (2.5Y 6/2, dry; 2.5Y 4/2, moist) when crushed; slightly hard; massive; violent effervescence with acid; few carbonate segregations; common crystalline masses of salt; many, clear quartz grains and colored mineral grains; clear, smooth boundary.

C-D2 43 to 51 inches, fine silty clay loam that is light brownish gray to dark grayish brown (2.5Y 6/2, dry; 2.5Y 4/2, moist) when crushed; hard; massive; violent effervescence with acid; many crystalline masses of salt; clear, smooth boundary.

C-D3 51 to 60 inches, fine silty clay loam that is light brownish gray to dark grayish brown

(2.5Y 6/2, dry; 2.5Y 4/2, moist) when crushed; hard; massive; violent effervescence with acid; common crystalline masses of salt.

HOUDEK SERIES

The Houdek series is made up of well-drained, medium-textured soils. These soils belong to the Chernozem great soil group. They have formed from loamy glacial till in gently sloping to steep areas in the eastern part of the county. In the steep areas, the soils are very thin and weakly developed. In areas with low morainal ridges, mainly in the four townships in the northeastern corner of the county, the soils may have a subsoil and substratum that consist of stratified silt and sand and some clay and gravel.

A profile 200 feet north and 250 feet west of the S. 1/4 cor. of sec. 27, T. 113 N., R. 67 W., is as follows:

A1 0 to 7 inches, dark grayish-brown to very dark grayish-brown (10YR 4/2-4/1, dry; 3/2-2/2, moist) loam; gray to very dark grayish brown (10YR 4/1-3/2, dry; 3/2, moist) when crushed; slightly hard; very weak, irregular, prismatic and very weak, very fine, granular structure; clear, smooth boundary.

B2 7 to 15 inches, dark grayish-brown to very dark grayish-brown (10YR 4/2, dry; 3/2, moist) loam; dark grayish brown (10YR 4/2-5/3, dry; 4/2, moist) when crushed; slightly hard; weak, medium, prismatic and very weak, very fine, granular structure; very thin, discontinuous coatings on the peds; clear, smooth boundary.

B3 15 to 22 inches, light brownish-gray to dark grayish-brown (10YR 6/2, dry; 4/2, moist) loam; light brownish gray to brown (10YR 6/2, dry; 5/3, moist) when crushed; slightly hard; very weak, medium, prismatic structure; very thin, discontinuous coatings on the peds; strong effervescence with acid; clear, smooth boundary.

B3ca 22 to 32 inches, light-gray to grayish-brown and brown (10YR 7/2, dry; 5/2, 5/3, moist) loam; light gray to brown (10YR 7/2-7/3, dry; 5/3, moist) when crushed; few, fine, faint, brownish-yellow (10YR 6/6) mottles; slightly hard; very weak, medium, prismatic structure; violent effervescence with acid; few carbonate segregations; clear, smooth boundary.

C 32 to 49 inches, light-gray to brown (10YR 7/2, dry; 5/3, moist) loam; same color when crushed; few, fine, faint, brownish-yellow (10YR 6/6) mottles; slightly hard; massive; violent effervescence with acid.

The A horizon consists of loam or silt loam and is 4 to 8 inches thick. It is thickest in nearly level areas where the Houdek soils intergrade to the Bonilla soils and thinnest on steep slopes where they intergrade to the Zahl soils. The B horizon consists of loam and is from 10 to 24 inches thick. Like the A horizon, it is thickest in nearly level areas. The soils are calcareous at a depth of 14 to 20 inches. Normally, there is a zone of secondary carbonate accumulation in the lower part of the B horizon and the upper part of the C. The carbonate is in soft segregations that may be more or less spherical and are about one-fourth inch in diameter. Generally, it occurs as thin seams between and in the structural units. In many places the C horizon of loam glacial till has platy structure that is not discernible unless the soil is extremely dry. The substratum is slightly to moderately saline and is slowly permeable.

HOVEN SERIES

The soils of the Hoven series are poorly drained, have a claypan, and occur in shallow depressions. The claypan is generally at a depth of 1 to 5 inches. These soils belong to the solodized-Solonetz great soil group. The parent material of at least the upper part of the profile is alluvium that washed from the surrounding slopes. The substratum is glacial till, loess, or alluvium.

A profile 107 feet east and 62 feet south of the NW cor. of NE1/4NW1/4 sec. 5, T. 113 N., R. 69 W., is as follows:

A1 0 to 2 inches, gray to black (10YR 5/1-5/2, dry; 2/1, moist) silt loam or loam; dark gray to black (10YR 4/1, dry; 2/1, moist) when crushed; slightly hard; weak, very thin, platy structure; abrupt, smooth boundary.

A2 2 to 5 inches, very dark gray (10YR 3/1, moist) silt loam; light gray (10YR 7/1, dry) on the ped surfaces facing up and gray (10YR 6/1, dry) on ped surfaces facing down; gray to very dark gray (10YR 5/1, dry; 3/1-2/2, moist) when crushed; slightly hard; weak, very thin, platy and very weak, fine, prismatic structure; abrupt, smooth boundary.

B2 5 to 15 inches, dark-gray to very dark gray (10YR 4/1, dry; 3/1, moist) fine silty clay loam; gray to very dark gray (10YR 5/1, dry; 3/1, moist) when crushed; very hard; weak, irregular, medium, prismatic and very weak, irregular, fine, subangular blocky structure; thin, discontinuous coatings on the peds; clear, smooth boundary.

B31 15 to 29 inches, dark-gray to very dark gray (10YR 4/1, dry; 3/1, moist) coarse silty clay; gray to very dark gray (10YR 5/1-4/1, dry; 3/1, moist) when crushed; very hard; very weak, irregular, medium, prismatic and very weak, irregular, fine, subangular blocky structure; very thin, discontinuous coatings on the peds; clear, smooth boundary.

B32 29 to 35 inches, dark-gray and very dark gray (10YR 4/1, dry; 3/1, moist) coarse silty clay; very slight effervescence with acid; alluvium in this layer and those below appears to have accumulated rapidly so that soil formation occurred at intervals and discontinuously; horizons of present profile are hard to determine.

D1 35 to 41 inches, dark-gray to very dark gray (10YR 4/1, dry; 3/1, moist) silty clay or silty clay loam; strong effervescence with acid; few salt crystals.

D2 41 to 54 inches, dark-gray to very dark gray (10YR 4/1, dry; 3/1, moist) coarse silty clay loam; slight effervescence with acid.

D3 54 to 60 inches, gray to very dark gray (10YR 5/1, dry; 3/1, moist) silty clay loam; slight effervescence with acid in part of matrix.

D4 60 to 65 inches, light brownish-gray to dark grayish-brown (2.5Y 6/2, dry; 4/2, moist) silty clay loam; slight effervescence with acid.

The A2 horizon consists of silty clay loam, silt loam, or loam. Where the claypan is at least an inch below the surface, there is a thin A1 horizon. The Hoven soils with the thickest A horizon generally are in the wetter depressions, and they intergrade to the Tetonka soils. The B horizon is made up of silty clay loam or silty clay. The C horizon, where present, may consist of glacial till of loam texture, loess of silt loam texture, or of silty, loamy, or clayey alluvium. The lower part of the B horizon and the C horizon generally are saline.

HURLEY SERIES

The Hurley series is made up of somewhat poorly drained, fine-textured soils that are on low, nearly level stream terraces in the southwestern part of the county. These soils belong to the solodized-Solonetz great soil group. They consist of alluvium deposited by floodwaters of streams and by runoff from adjacent slopes occupied by Promise soils. Most of the alluvium was originally weathered from Pierre shale. Some material in the substratum was washed from glacial deposits and consists of silty clay loam, loam, or gravelly sediments.

A profile 200 feet south and 100 feet east of the NE cor. of sec. 31, T. 109 N., R. 70 W., is as follows:

A2 0 to 1 1/2 inches, silty clay loam that is grayish brown to very dark grayish brown (2.5Y 5/2, dry; 3/1, moist) when crushed; slightly hard; weak, very thin, platy structure; clear, smooth boundary.

A3-B1 1 1/2 to 3 inches, dark-gray to black (2.5Y 4/1, dry; 2/1, moist) silty clay loam; the material in this horizon and lower horizons is the same color when soil is crushed; very hard; weak, very fine, subangular blocky structure; clear, smooth boundary.

B21 3 to 6 inches, dark-gray to black (10YR 4/1, dry; 2/1, moist) clay; very hard; weak, very fine, subangular blocky structure; moderate, continuous coatings; blocks tend to be arranged into fine columns; clear, smooth boundary.

B22 6 to 11 inches, gray to very dark gray (10YR 5/1, dry; 3/1, moist) clay; very hard; weak, very fine, subangular blocky structure; moderate, continuous coatings; few gypsum crystals in lower part of layer; gradual, smooth boundary.

Ccs1 11 to 24 inches, clay that has colors similar to those of the B22 horizon; very hard; very weak, subangular blocky structure; strong effervescence with acid; many gypsum crystals occur in masses and in seams between structural units; gradual, smooth boundary.

Ccs2 24 to 54 inches, grayish-brown to very dark grayish-brown (10YR 5/2-4/2, dry; 3/2, moist) clay; very hard; very weak, very fine, subangular blocky structure; strong effervescence with acid; many gypsum crystals occur in masses and in seams between structural units; gradual, smooth boundary.

Ccs3 54 to 60 inches, grayish-brown to dark grayish-brown (10YR 5/2, dry; 4/3, moist) clay; very hard; massive; weak effervescence with acid; many gypsum crystals occur in masses and in seams.

The A1 horizon, if present, consists of loam and is less than an inch thick. In most areas, however, the A2 horizon is at the surface. It is about an inch thick and consists of silt loam or loam. In some areas the A2 horizon is underlain by the B2, but in many areas there is a transitional zone between the two. This zone is an A3-B1 horizon of silty clay loam or coarse silty clay, about an inch thick. The B horizon consists of clay and is 6 to 12 inches thick. It is saline, except in the upper part, in many areas. The lower part of the profile is saline, and in many places it contains lathe-shaped crystals of gypsum.

LADELLE SERIES

The LaDelle series is made up of well drained to moderately well drained soils that consist of medium to moderately fine textured alluvium. These soils belong to the Chernozem great soil group. They are on terraces along streams and on nearly level foot slopes adjacent to hills. Most areas are no longer flooded. There are three soil types of the LaDelle series in Hand County. A description of each follows.

LaDelle loam.--This soil type is made up of alluvium that eroded from the Ree and the Wessington Hills and was deposited as fans at the bases of these hills. In many places the alluvium is stratified. The texture of the strata ranges from gravel to silty clay loam but is mostly loam.

LaDelle loam has an A horizon of loam texture that is normally 6 to 8 inches thick. The B horizon generally consists of loam, but it may be silt loam or coarse silty clay loam. It is 24 to 30 inches thick. The texture of the C horizon ranges from sandy loam to silty clay loam. In some areas there are buried, dark-colored former surface layers in the C horizon and in the substratum.

Except for the texture of the surface layer, the profile of LaDelle loam is essentially the same as the profile of LaDelle silt loam that follows.

LaDelle silt loam.--This soil type occurs on nearly level terraces along streams in the northern half and in the south-central part of the county. Most of the terraces are not flooded by streams. The alluvium, particularly that in the lower part of the profile, is variable and ranges from silty clay loam to sand in texture. In places the profile has some gravelly strata.

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A profile of LaDelle silt loam (see laboratory data in table 13) 150 feet south and 30 feet west of the center of sec. 31, T. 113 N., R. 66 W., is as follows:

A1p 0 to 5 inches, between very dark gray and very dark grayish-brown to very dark brown (10YR 3/1.5, dry; 2/2, moist), noncalcareous silt loam; moderate, fine, granular structure; abrupt, smooth boundary.

B2 5 to 16 inches, between very dark gray and very dark grayish-brown or very dark brown (10YR 3/1.5, dry; 2/2, moist), noncalcareous silty clay loam; very dark grayish brown (10YR 3/2) when crushed; weak to moderate, coarse, prismatic structure that breaks to moderate, medium, subangular blocky structure; slightly hard when dry, friable when moist; clear, smooth boundary.

Bca 16 to 31 inches, dark grayish-brown (2.5Y 4/2, moist), very calcareous fine loam; friable; weak, fine, granular structure; moderate amount of segregated lime occurs as threads and elongated nodules; gradual, smooth boundary.

Cca 31 to 47 inches, dark grayish-brown (2.5Y 4/2, moist), very calcareous fine loam; friable; weak, granular structure to massive; a moderate amount of segregated lime, as in the horizon above; clear, smooth boundary.

C1 47 to 60 inches, light olive-brown (2.5Y 5/4, moist), moderately calcareous loam; very friable when moist; clear, smooth boundary.

D 60 inches+, calcareous sand.

The A horizon consists of silt loam and is 6 to 10 inches thick. The A and the upper part of the B horizon normally are leached of carbonate, but, in some areas where the LaDelle soils intergrade to the Lamoure, the upper B horizon may be calcareous. The B horizon is 20 to 28 inches thick. In most places it consists of silt loam, but in some it is loam or silty clay loam. In some areas the profile contains buried former surface layers.

LaDelle silty clay loam.--This moderately well drained soil type is along small streams. There are two phases of this type in the county. One phase, LaDelle silty clay loam, fans, nearly level, occurs on fans adjacent to the Ree, the Wessington, and the Orient Hills. The other, LaDelle silty clay loam, nearly level, is in the southern part of the county, mainly on fan alluvium that was deposited on low terraces. It is within what is normally considered the area of Chestnut soils. The lower part of the profile or the substratum of LaDelle silty clay loam, fans, nearly level, consists of till, and that of LaDelle silty clay loam, nearly level, consists of stream alluvium.

A profile (see table 13 for laboratory data) of LaDelle silty clay loam, fans, nearly level, 400 feet north and 120 feet east of the SW cor. of sec. 34, T. 112 N., R. 66 W., is as follows:

A1p 0 to 6 inches, dark-gray to between very dark gray and black (10YR 4/1, dry; 2.5/1, moist), noncalcareous silty clay loam; hard when dry, friable when moist; abrupt, smooth boundary.

B2 6 to 13 inches, dark grayish-brown to very dark brown (10YR 4/2, dry; 2/2, moist) fine silty clay loam; very dark grayish brown (10YR 3/2, moist) when crushed; moderate, medium, prismatic structure that breaks to moderate, fine, subangular blocky structure; hard when dry, friable when moist; gradual, smooth boundary.

B2ca 13 to 18 inches, dark grayish-brown to very dark grayish-brown (10YR 4/2, dry; 3/2, moist), very calcareous silty clay loam; moderate, medium, prismatic structure that breaks to weak, medium, subangular blocky structure; hard when dry, friable when moist; few carbonate segregations; clear, smooth boundary.

B3ca 18 to 35 inches, pale-yellow and white to light olive-brown (2.5Y 7/3, 8/2, dry; 5.5/4, moist), very calcareous loam; weak, medium, subangular blocky structure; friable when moist, hard when dry; common carbonate segregations; clear, smooth boundary.

C1ca 35 to 49 inches, pale-yellow and white to light olive-brown and white (2.5Y 7/3, 8/2, dry; 5.5/4, 8/0, moist), very calcareous loam; common carbonate segregations; hard when dry, friable when moist.

C2 49 to 60 inches, mottled grayish-brown and light olive-brown (2.5Y 5/2, 5/6, moist), very calcareous loam without visible segregated carbonates; hard when dry, friable when moist.

The horizons of LaDelle silty clay loam are slightly thinner than those of LaDelle silt loam. The texture of the A, B, and C horizons generally is silty clay loam or clay loam.

LAMOURE SERIES

The Lamoure series consists of deep, medium-textured, poorly drained soils on low stream terraces bordering bottom lands in the northern half and south-central part of the county. These soils belong to the Humic Gley great soil group. They are made up of alluvial materials, mainly silt loam or silty clay loam. In the substratum, however, coarser material may occur. Some areas are flooded occasionally by streams or by runoff water from the adjacent uplands.

A profile 0.5 mile north of the SE cor. of sec. 14, T. 112 N., R. 66 W., is as follows:

A11 0 to 9 inches, very dark gray (10YR 3/1, dry) to black (10YR 2/1, moist), slightly calcareous silt loam; very weak, fine, granular structure; soft when dry, friable when moist; clear, smooth boundary.

A12 9 to 16 inches, dark-gray (10YR 4/1, dry) to very dark gray (10YR 3/1, moist), moderately calcareous silty clay loam; weak, medium, prismatic structure; slightly hard when dry, friable when moist; clear, smooth boundary.

Cgca1 16 to 30 inches, grayish-brown (2.5Y 5/2, dry) to dark grayish-brown (2.5Y 4/2, moist) alluvial parent material of silty clay loam texture; mottled with faint spots of light brownish gray (2.5Y 6/2, moist) and distinct spots of segregated carbonates; firm; strong

effervescence with acid; clear, smooth boundary.

Cgca2 30 to 60 inches, light brownish-gray (2.5Y 6/2, dry) to grayish-brown (2.5Y 5/2, moist) alluvial parent material of silty clay loam texture; mottled with faint spots of dark grayish brown (2.5Y 4/2, moist) and distinct spots of segregated carbonates; firm; strong effervescence with acid.

The A horizon is 8 to 18 inches thick and normally is slightly to moderately calcareous. The surface layer consists of silt loam, but the lower layers range from loam to silty clay loam and may contain sandy or gravelly strata. In most places the Lamoure soils do not have a B horizon. The C horizon is very calcareous, has soft accumulations of secondary carbonates, and is mottled.

LANE SERIES

The Lane series is made up of deep, dark-colored soils that consist of medium- to fine-textured alluvium. These soils belong to the Chernozem great soil group. They are on nearly level to gently sloping foot slopes or on nearly level terraces along streams. The soils of the Lane series range from well drained to poorly drained. There are four soil types of the Lane series in Hand County. A description of each follows.

Lane loam.--The soils of this type are deep and are well drained to moderately well drained. They have a loamy, moderately permeable profile and a slowly permeable substratum. They are on the gentle foot slopes of the Ree and the Wessington Hills. The alluvial parent material was washed from these hills by small streams and deposited in coalescing fans. It is mainly loam or silt loam, but there may be strata of sand or gravel in the lower part. The thickness of the alluvium varies. In most areas the substratum of glacial till is at a depth of 3 to 6 feet.

A profile 375 feet west and 100 feet north of the E. 1/4 cor. of sec. 1, T. 109 N., R. 66 W., is as follows:

Ap 0 to 5 inches, dark-gray to black (10YR 4/1, dry; 2/1-2/2, moist) silt loam; very dark grayish brown (10YR 3/2, moist) when crushed; slightly hard clods, caused by tillage, and weak, very fine, granular structure; abrupt, smooth boundary.

A12 5 to 10 inches, same color and texture as the Ap horizon; hard; very weak, fine, granular and very weak, fine, prismatic structure; gradual, smooth boundary.

B21 10 to 15 inches, fine clay loam that is the same color as the material in the Ap horizon; very hard; fine, moderate, prismatic and moderately weak, fine, subangular blocky structure; moderate and thin, continuous coatings; gradual, smooth boundary.

B22 15 to 20 inches, very dark grayish-brown (2.5Y 3/2, dry or moist) clay loam; very hard; moderate, fine, prismatic and moderately weak, fine, subangular blocky structure; moderate and thin, continuous coatings; slight effervescence with acid; gradual, smooth boundary.

B3ca 20 to 23 inches, same color and texture as the B22 horizon; hard; weak, medium, prismatic and very weak, fine, subangular blocky structure; thin, discontinuous coatings on prisms; violent effervescence with acid; clear, smooth boundary.

Cca 23 to 60 inches, grayish-brown to dark grayish-brown (2.5Y 5/2, dry; 4/2, moist) clay loam; dark grayish brown (2.5Y 4/2, moist) when crushed; hard; very weak, medium, prismatic structure in upper part of layer with a few, thin, discontinuous coatings; structure becomes weaker with increasing depth, and parent material is more compact and till-like; no sharp boundary occurs between the alluvium and till.

The A horizon is 4 to 10 inches thick. It is generally thin near hills where the soil is steep, but it is thick where the soil is nearly level. Near the hills, the A horizon consists of loam, but in some areas farther away from the hills, the surface layer is generally silt loam. The loam to clay loam B horizon has moderately well developed prisms in sites that no longer receive deposits of alluvium and has weakly developed prisms in sites that have recently received deposits.

Lane silty clay.--The soils of this type are deep, generally moderately well drained to somewhat poorly drained, and slowly permeable. In most areas the material in the upper 30 inches of the profile is silty clay or clay. The lower layers consist of glacial till of clay loam or loam texture; medium, moderately fine, or fine textured alluvium; or sand and gravel. Lane silty clay occurs near the bases of alluvial fans, on stream terraces, or in nearly level areas in which runoff water accumulates. Although the soils of the Lane series are classified in the Chernozem great soil group, Lane silty clay resembles soils of the Grumusol great soil group.

A profile 70 feet north and 0.2 mile west of the SE cor. of sec. 14, T. 111 N., R. 66 W., is as follows:

Ap 0 to 4 inches, very dark gray to black (10YR 3/1, dry; 2/1, moist) silty clay; very dark gray (10YR 3/1-4/1, dry; 3/1, moist) when crushed; very hard; weak, very fine, granular structure to cloddy; abrupt, smooth boundary.

B21-B1 4 to 10 inches, dark-gray to very dark gray (10YR 4/1-4/2, dry; 3/1-3/2, moist) silty clay; dark gray to very dark gray (10YR 4/1, dry; 3/1, moist) when crushed; extremely hard; weak, medium, prismatic structure with irregular, rough sides and very weak, fine, subangular blocky structure with thin, continuous coatings; strong effervescence with acid; few pebbles and some gravel are in this layer; gradual, irregular boundary.

B22 10 to 16 inches, dark-gray to very dark gray (10YR 4/1, dry; 3/1, moist) silty clay; dark gray to very dark grayish brown (10YR 4/1, dry; 3/2-3/1, moist) when crushed; extremely hard; weak, medium, prismatic and very weak,

fine, subangular blocky structure; thin, continuous coatings on the peds; violent effervescence with acid; few pebbles and some gravel; tongues of dark-colored material extend into this layer from the layer above; gradual, irregular boundary.

B23 16 to 26 inches, grayish-brown to dark grayish-brown (2.5Y 5/2-5/1, dry; 4/2, moist) silty clay; grayish brown to dark grayish brown (10YR 5/2, dry; 2.5Y-10YR 4/2, moist) when crushed; extremely hard; weak, medium, prismatic and very weak, fine, subangular blocky structure; thin, continuous coatings on the peds; violent effervescence with acid; few carbonate segregations and concretions; tongues of dark-colored material extend into this layer from the layer above; gradual, irregular boundary.

B3 26 to 35 inches, grayish-brown to dark grayish-brown (2.5Y-10YR 5/2, dry; 4/2, moist) silty clay; grayish brown to very dark grayish brown (2.5Y-10YR 5/2, dry; 3/2, moist) when crushed; extremely hard; weak, medium, prismatic and very weak, fine, subangular blocky structure; very thin, discontinuous coatings on the peds; violent effervescence with acid; few carbonate segregations and concretions; some dark-colored tongues extend into this layer from upper horizons; clear, smooth boundary.

B3ca 35 to 40 inches, light brownish-gray to dark grayish-brown (2.5Y-10YR 6/2, dry; 4/2, moist) coarse silty clay loam; same color when crushed; very hard; very weak, medium, prismatic and very weak, fine, subangular blocky structure; violent effervescence with acid; many carbonate segregations and few carbonate concretions; few, fine concretions of manganese and iron; clear, smooth boundary.

D1 40 to 55 inches, dark-gray and grayish-brown to dark grayish-brown (10YR 4/1, 5/2, dry; 4/2, moist) coarse sandy loam from strata of loam and sand; same color when crushed; violent effervescence with acid; abrupt, smooth boundary.

D2 55 to 60 inches, pale-brown to dark grayish-brown (10YR 6/3-6/2, dry; 4/2, moist) silty clay loam; light brownish gray to dark grayish brown (10YR 6/2, dry; 4/2-4/3, moist) when crushed; violent effervescence with acid.

The A horizon consists of silty clay or clay and is 3 to 6 inches thick. Normally, it is noncalcareous, but in a few areas it is calcareous. The silty clay or clay B horizon varies in different areas because of difference in the parent material. In many areas, it contains dark-colored tongues of surface material. Presumably, this material fell into cracks that formed in the soil during droughts.

Lane silty clay loam.--This soil type is deep and moderately well drained to somewhat poorly drained. Most of it occurs with the Exline soils on fans below the Ree, the Wessington, and the Orient Hills and also on stream terraces in the northeastern part of the county. The soils on fans generally are underlain by glacial till; those on terraces may be underlain by stratified sediments that have some sandy and gravelly layers. Lane silty clay loam also occurs with Harriet soils in the southwestern part of the county. Here, it occupies low terraces that may be flooded. The parent material that was deposited by floodwaters is very heterogeneous and ranges from silty clay to loam in texture. A few small areas have a seasonally high water table and are saline at the surface.

A profile of Lane silty clay loam, which intergrades to the Alluvial or Humic Gley great soil groups, one-eighth mile east of the bridge across Elm Creek in the west-central part of sec. 33, T. 111 N., R. 70 W., is as follows:

A0-A1p 0 to 1 inch, very dark gray to black (2.5Y 3/1-4/1, dry; 2/1, moist) silty clay loam; same color when crushed; weak to moderate, very fine, granular structure; quartz grains are predominantly dark, but some are fine and clear; clear, smooth boundary.

A1p 1 to 5 inches, very dark gray to black (2.5Y 3/1-4/1, dry; 2/1, moist), friable silt loam; same color when crushed; slightly hard; moderate, fine and very fine, granular structure; quartz grains are predominantly dark, but some are fine and clear; abrupt, smooth boundary.

A1 5 to 8 inches, very dark gray to black (2.5Y 3/1, dry; 2/1, moist) loam; same color when crushed; slightly hard; weak, medium, blocky structure that breaks to fine and very fine, granular structure; quartz grains are predominantly dark, but some are fine and clear; clear, smooth boundary.

B21 8 to 12 inches, very dark gray to black (2.5Y 3/1-4/1, dry; 2.5Y 2/1, moist) silty clay loam; dark gray to black (10YR 4/1, dry; 2/1, moist) when crushed; slightly hard; weak to moderate, medium, blocky and moderate, fine and very fine, subangular blocky structure; thin, discontinuous clay coatings; quartz grains in this and the next three lower layers are like those in the A1 horizon; clear, smooth boundary.

B22 12 to 25 inches, dark-gray to black (2.5Y 4/1, dry; 2/1-2/2, moist) silty clay; same color when crushed; hard; moderate, medium, subangular blocky and moderate to strong, fine, subangular blocky structure; thin, continuous coatings and moderate, discontinuous coatings; clear, irregular boundary.

B-Ccacs 25 to 28 inches, dark-gray to very dark gray (2.5Y 4/1-5/1, dry; 3/1-2/2, moist) silty clay; same color when crushed; hard; weak to moderate, fine, subangular blocky structure; thin, continuous coatings on vertical faces of peds; slight effervescence with acid; few carbonate segregations; few masses of salt; clear, smooth boundary.

Ccacs1 28 to 37 inches, dark-gray to very dark gray (2.5Y 4/1-5/1, dry; 3/1-3/2, moist) clay; same color when crushed; very hard; weak to moderate, fine, subangular blocky structure; thin, continuous coatings on vertical faces; strong effervescence with acid; many carbonate segregations; few masses of salt.

Ccacs2 37 to 42 inches, gray to dark-gray (5Y 5/1-5/2, dry; 4/1, moist) clay; very hard;

weak, fine, subangular blocky structure; thick, continuous coatings on the vertical faces; strong effervescence with acid; many carbonate segregations; common masses of salt; clear, smooth boundary.

Cca-Cgcs 42 to 45 inches, gray to dark-gray (5Y 5/1-5/2, dry; 4/1, moist) clay; very hard; massive; few carbonate segregations; common to many masses of salt; fine, clear quartz grains in this and lower horizon; clear, smooth boundary.

Cgcs 45 to 60 inches, gray to dark-gray (5Y 5/1-6/1, dry; 4/1-5/1, moist) clay with common, fine, faint, pale-olive to olive (5Y 6/3, dry; 4/3, moist) mottles; massive; slight effervescence with acid; many masses of salt.

Where Lane silty clay loam is associated with Exline silty clay loam, it has a silty clay loam A horizon, 4 to 8 inches thick; a silty clay loam or silty clay B horizon, 15 to 25 inches thick; and a silty clay, silty clay loam, or loam C or D horizon that may consist of stratified alluvium or glacial till. Where Lane silty clay loam is associated with the Harriet soil, the horizons are similar to those described, but in many places, they are not so strongly developed and the soils intergrade to the Alluvial or Humic Gley great soil group.

LISMAS SERIES

The Lismas series is made up of excessively drained soils that have shale in the subsoil. These soils belong to the Lithosol great soil group. They occur where geologic erosion has been rapid, mainly on steep slopes in the southwestern corner of the county. Most areas are along the valley of Elm Creek. The soils have formed from shale that may have been altered in the upper foot by glaciers.

A profile 75 feet south and 75 feet west of the NE cor. of sec. 7, T. 110 N., R. 70 W., is as follows:

A1 0 to 2 inches, grayish-brown to dark grayish-brown (2.5Y 5/2, dry; 10YR-2.5Y 4/2, moist) silty clay; soft; moderate, fine and very fine, granular structure; slight to strong effervescence with acid; few, fine, clear and dark quartz grains; clear, smooth boundary.

B1 2 to 8 inches, dark grayish-brown to dark-brown (2.5Y 4/2, dry; 10YR-2.5Y 4/3, moist) silty clay or clay; slightly hard; weak, coarse prisms and weak, fine and very fine plates of shale; thin, discontinuous coatings on the sides of prisms; slight to strong effervescence with acid; few, fine quartz grains; clear, irregular boundary.

B2 8 to 13 inches, this horizon is similar to the B1 horizon but it has common, fine, faint, yellowish-brown (10YR 5/5-5/4) mottles; also, the prisms are weaker and the horizontal faces of the shale plates have thin, discontinuous coatings; clear, smooth boundary.

Ccacs 13 to 19 inches, light yellowish-brown to brown (2.5Y 6/4, dry; 10YR-2.5Y 4/3-5/4, moist) clay with common, fine, faint, yellowish-brown (10YR 5/4-5/6) mottles; few carbonate segregations; many masses and segregations of salt; clear, irregular boundary.

C-Dcacs 19 to 32 inches, pale-yellow to dark yellowish-brown (2.5Y 7/4, dry; 10YR-2.5Y 4/4, moist) clay with common, fine, faint, yellowish-brown (10YR 5/6-5/4) mottles; slightly hard; moderate, fine and very fine shale plates; slight effervescence with acid; few carbonate segregations; common masses and segregations of salt; clear, irregular boundary.

Dcacs 32 to 60 inches, pale-yellow to brown (2.5Y 7/3, dry; 10YR-2.5Y 5/3, moist) clay; very hard; strong, medium and fine shale plates; few carbonate segregations.

The silty clay A horizon is normally less than 3 inches thick. In some areas the surface layer is underlain by 10 to 25 inches of silty clay that has weak prisms formed in partly disintegrated shale fragments. This layer could be called either a B or C horizon. In most places bedded shale is within 20 inches of the surface. Some glacial gravel and sand may occur in the upper part of the profile.

McKENZIE SERIES

The McKenzie series is made up of poorly drained soils that occur in the western and southern parts of the county. These soils are classified in the solodized-Solonetz great soil group in this report, but they have some characteristics of Grumusols. They are made up of clay or silty clay alluvium deposited in low slack-water basins during and following the last glacial period. Drainage outlets have formed in the basins. The upper 30 inches of the soil profile is clay or silty clay. In most areas the lower layers are also fine textured, but, in a few, they consist of glacial till or moderately fine textured sediments.

The McKenzie soils have an uneven surface, or microrelief. The microrelief consists of small microknolls, a few inches high and about 3 feet across, interspersed with microbasins. The soils in the two micropositions differ.

In the microbasins there is a thin, platy, gray A horizon that is normally of silty clay loam texture; a weakly developed claypan that is 6 to 20 inches thick and has columnar structure; and a light-colored C horizon that is of clay texture and is saline.

In the microknolls there is a granular, very dark gray or very dark grayish-brown A horizon of clay texture. This horizon is 2 to 3 inches thick. It is underlain either by a B horizon of light-colored, very weakly developed clay that has prismatic and subangular blocky structure or by a clay C horizon that has very weak, blocky structure.

The McKenzie soils are generally calcareous. Those in microbasins contain salts below a depth of 10 to 25 inches, and those in microknolls contain salts at the surface or at a depth of a few inches.

MADDOCK SERIES

The soils of the Maddock series are well drained. These soils belong to the Chernozem great soil

group. Their parent material was deposited by glacial melt water and was later blown about by the wind. In most areas the substratum is made up of loamy sand that contains some pebbles and stones. In a few places, it consists of glacial till.

A profile about 3 miles east of Hand County in Spink County, E. 1/4 cor. of sec. 27, T. 115 N., R. 65 W., is as follows:

A1 0 to 10 inches, dark-gray to very dark gray (10YR 4/1, dry; 3/1, moist), noncalcareous sandy loam; weak, very coarse, prismatic structure; slightly hard when dry, very friable when moist; gradual, smooth boundary.

B2 10 to 17 inches, dark grayish-brown to very dark grayish-brown (10YR 4/2, dry; 3/2, moist), noncalcareous sandy loam; weak, very coarse, prismatic structure; slightly hard when dry, very friable when moist; clear boundary, except that the color boundary to the horizon below is very gradual.

B3 17 to 27 inches, dark-brown to between brown and dark-brown (10YR 3/3, dry; 4/3, moist), noncalcareous loose sand; gradual, smooth boundary.

C1ca 27 to 42 inches, pale-brown to brown (10YR 6/3, dry; 5/3, moist), weakly calcareous loose sand.

The dark-colored sandy loam A horizon is 10 to 20 inches thick. In most areas the soils have a B horizon of sandy loam to sand that is about 20 inches thick. In areas where wind erosion has been active recently, however, some soils lack a B horizon. The C horizon is normally loose sand.

MIRANDA SERIES

The soils of the Miranda series are deep, but they have a claypan at or near the surface. These soils belong to the solodized-Solonetz great soil group. They are in uplands in all parts of the county. Their parent material consists of glacial till, loess, or local alluvium or a combination of these materials. The soils range from poorly drained to well drained, but are mainly moderately well drained to somewhat poorly drained.

A profile 115 feet south and 203 feet west of the NE cor. of NW 1/4 NE 1/4 sec. 2, T. 113 N., R. 70 W., is as follows:

A2 0 to 3 inches, dark-gray and gray to very dark gray (10YR 4/1, 5/1, dry; 3/1, moist) loam or silt loam; gray to very dark gray (10YR 6/1, dry; 3/1, moist) when crushed; soft; weak, very thin or fine, platy to granular structure and weak, medium, prismatic structure; few, clear or coated quartz grains; abrupt, smooth boundary.

B2 3 to 7 inches, dark-gray and gray to very dark gray (10YR 4/1, 5/1, dry; 3/1, moist) silty clay loam; dark gray to very dark gray (10YR 4/1, dry; 2.5Y 3/1, moist) when crushed; very hard; weak, medium, prismatic and very weak, very fine, subangular blocky structure; thin, continuous coatings on peds; gradual, smooth boundary.

B3 7 to 15 inches, light brownish-gray to dark grayish-brown (2.5Y 6/2, dry; 4/2-4/3, moist) silty clay loam; light brownish gray to grayish brown (2.5Y 6/2, dry; 5/2, moist) when crushed; very hard; very weak, medium, prismatic structure; very thin, discontinuous coatings on the prism faces; slight effervescence with acid; clear, smooth boundary.

B3ca 15 to 27 inches, light brownish-gray to olive-brown (2.5Y 6/2, dry; 4/3, moist) silty clay loam; light brownish gray to grayish brown (2.5Y 6/2, dry; 5/2, moist) when crushed; very hard; very weak, medium, prismatic structure; very thin, discontinuous coatings on the prism faces; violent effervescence with acid; common carbonate segregations; clear, smooth boundary.

C1 27 to 32 inches, light yellowish-brown and light-gray to grayish-brown and gray (2.5Y 6/3, 7/2, dry; 5/2, 5/1, moist) silty clay loam; light brownish gray to grayish brown (2.5Y 6/2, dry; 5/2, moist) when crushed; massive; slight effervescence with acid; common crystalline salt masses; clear, smooth boundary.

C2cs 32 to 39 inches, light brownish-gray and pale-yellow to grayish-brown and light yellowish-brown (2.5Y 6/2, 7/4, dry; 5/2, 6/4, moist) silty clay loam; light brownish gray to olive brown (2.5Y 6/2, dry; 4/4, moist) when crushed; few, fine, indistinct, brownish-yellow (10YR 6/6) mottles; hard; massive; slight effervescence with acid; many crystalline salt masses; clear, smooth boundary.

C3 39 to 60 inches, light-gray and light yellowish-brown to grayish-brown and light olive-brown (2.5Y 7/2, 6/4, dry; 5/2, 5/4, moist) coarse clay loam; pale yellow to olive brown (5Y 7/3, dry; 2.5Y 4/4, moist) when crushed; hard; medium lamina that break to irregular subangular blocks; thin, continuous coatings on the blocks; slight effervescence with acid; common crystalline salt masses; the material in this layer may be platy till.

The medium or moderately fine textured A1 horizon, if present, is 1 or 2 inches thick. The loam or silt loam A2 horizon may be less than 2 inches thick, and in many places it is at the surface. The B2 horizon is made up of clay loam, silty clay loam, or silty clay. It has columnar structure, is 18 to 30 inches thick, and generally has salts in the lower part. The C horizon and the D, if present, are slowly permeable and saline.

MONDAMIN SERIES

The Mondamin series is made up of moderately well drained to well drained soils that occur in the southern part of the county. These soils belong to the Chestnut great soil group. They have formed mainly in silty clay loam and, to a small extent, in silty clay alluvium of glacial age. These materials were deposited as small, flat-topped knolls. The knolls are normally a few acres in size, and they have short, steep slopes around their edges.

A profile (see table 13 for laboratory data) 415 feet north and 0.4 mile east of the SW cor. of sec. 2, T. 110 N., R. 70 W., is as follows:

A1 0 to 4 inches, fine silty clay loam that is very dark grayish brown to dark grayish brown (10YR-2.5Y 3.5/2, dry) with dark-gray (10YR-2.5Y 4/1, dry) coatings; very dark brown (10YR-2.5Y 2/2, moist) with black to very dark brown (10YR 2/2, moist) coatings; slightly hard when dry, friable when moist; weak, fine, granular and crumb structure; few, clear and dark quartz grains; clear, smooth boundary.

B21 4 to 9 inches, silty clay loam that is very dark grayish brown (2.5Y 3/2, dry) with very dark gray to dark-gray (10YR-2.5Y 3.5/1, dry) coatings; black to very dark brown (10YR-2.5Y 2/1.5, moist) with no discernible coatings; slightly hard when dry, friable to firm when moist; weak, medium, prismatic structure that breaks to weak, medium and fine, subangular blocky structure; thin, discontinuous coatings on the vertical faces of the primary structural peds; few, fine, clear and dark quartz grains; clear, wavy boundary.

B22 9 to 15 inches, fine silty clay loam that is dark grayish brown to grayish brown (2.5Y 4.5/2, dry) with very dark gray to dark-gray (2.5Y 3.5/2, dry) coatings; black to very dark grayish brown (2.5Y 2.5/2, moist) with black (2.5Y 2/1.5, moist) coatings; slightly hard to hard when dry, firm when moist; moderate, medium, subangular blocky structure with thin, continuous and moderate, discontinuous coatings; few, fine, clear and dark quartz grains; clear, irregular boundary.

B3cal 15 to 21 inches, moderately calcareous silty clay loam that is grayish brown to light brownish gray (2.5Y 5.5/2, dry) with dark-gray (2.5Y 4/1, dry) coatings; dark grayish brown (2.5Y 4/2, moist) with black (2.5Y 2/2, moist) coatings; slightly hard to hard when dry, firm when moist; weak to moderate, coarse, prismatic structure that breaks to medium, prismatic structure that, in turn, breaks to weak, subangular blocky structure with thin, discontinuous coatings; common to many, medium and small, soft carbonate segregations; few, fine, clear quartz grains; gradual, wavy boundary.

B3ca2 21 to 27 inches, weakly to moderately calcareous, coarse silty clay loam that is light olive brown (2.5Y 5/3, dry) with dark-gray (2.5Y 4/1, dry) coatings; olive brown (2.5Y 4/3, moist) with discontinuous, black (2.5Y 2/2, moist) coatings; hard when dry, firm to very firm when moist; moderate, medium, prismatic structure that breaks to weak to moderate, medium, blocky structure with moderate, discontinuous coatings; common, medium and soft carbonate segregations; few, fine, clear quartz grains; gradual, wavy boundary.

B3ca3 27 to 35 inches, weakly to moderately calcareous silty clay loam that is grayish brown to light brownish gray (2.5Y 5.5/2, dry) with few, fine and medium, distinct, strong-brown (7.5YR 5/6, dry) iron stains and discontinuous, dark-gray (2.5Y 4/1, dry) coatings; olive brown (2.5Y 4/3, moist) with few, fine and medium, distinct, dark-brown (7.5YR 3/4, moist) mottles and discontinuous, black (2.5Y 2/2, moist) coatings; hard when dry, very firm when moist; weak to moderate, medium, prismatic structure that breaks to weak, medium, blocky structure; thin, discontinuous coatings on the vertical and horizontal surfaces of the primary peds; common, medium and small, soft carbonate segregations; few, fine, clear quartz grains; gradual, wavy boundary.

B3cacs1 35 to 43 inches, moderately calcareous silty clay loam that is light olive gray (5Y 6/2, dry) with common, medium, faint, light-gray (5Y 7/1, dry) mottles and common, fine and medium, distinct, strong-brown (7.5YR 5/6, dry) mottles and also discontinuous, dark-gray (2.5Y 4/2, dry) mottles and discontinuous, dark-gray (2.5Y 4/2, dry) coatings; olive (5Y 4/3, moist) with common, medium, faint, gray (5Y 5/1, moist) mottles and common, fine and medium, distinct, dark reddish-brown (5YR 3/4, moist) mottles and also discontinuous, black coatings (2.5Y 2/2, moist); hard when dry, very firm when moist; weak to moderate, medium, blocky structure; thin, discontinuous coatings on the primary peds; few, medium, soft carbonate segregations and few, soft salt segregations; few, fine, clear quartz grains; gradual, wavy boundary.

B3cacs2 43 to 54 inches, moderately calcareous silty clay loam that is gray to light gray (5Y 6/1, dry) with many, medium and large, distinct, strong-brown (7.5YR 5/6, dry) mottles that occur as discontinuous coatings on the ped faces; dark gray to gray (5Y 4.5/1, moist) with many, medium and large, distinct, dark reddish-brown (5YR 3/4, moist) mottles that occur as discontinuous coatings on the ped faces; slightly hard to hard when dry, firm to very firm when moist; weak to moderate, medium, prismatic structure that breaks to weak, medium, blocky structure; thin, discontinuous coatings on primary peds; few, small and medium, hard carbonate concretions and few, soft salt segregations; few, fine, clear quartz grains; gradual, wavy boundary.

Cca 54 to 60 inches, moderately calcareous silty clay loam that is gray to light gray (5Y 6/1, dry) with many, medium and large, distinct, strong-brown (7.5YR 5/6, dry) mottles that occur as discontinuous coatings between the lamina; dark gray to gray (5Y 4.5/1, moist) with many, medium and large, distinct, dark reddish-brown (5YR 3/4, moist) mottles that occur as discontinuous coatings between the lamina; slightly hard to hard when dry, firm to very firm when moist; massive (structureless) to weak, medium silt and clay lamina; common, large, hard carbonate concretions; few, fine, clear quartz grains.

The silty clay loam A horizon is 3 to 6 inches thick. In a few areas, the A horizon consists of silt loam, and in others, silty clay. The silty clay loam or silty clay B horizon generally has prismatic structure and is 20 to 40 inches thick. There is a distinct zone of carbonate accumulation in the B horizon. The carbonate occurs mainly as soft segregations about one-fourth inch in diameter. The substratum is stratified and laminated. Most of the strata consist of silty clay loam, but some consist of silt, sand, or clay.

OAHE SERIES

The soils of the Oahe series are well drained to moderately well drained. They belong to the Chestnut great soil group. These soils are underlain by gravel at a depth of more than 20 inches. They are very permeable, and their gravelly substratum has a low water-holding capacity. The areas of Oahe soils are mainly along stream valleys on terraces of glacial age and in upland positions where melt water flowed along the margin of a glacier.

A profile 200 yards south and 100 yards east of the NW cor. of sec. 9, T. 109 N., R. 68 W., is as follows:

A1 0 to 4 inches, dark-gray to very dark grayish-brown (10YR 4/1, dry; 3/2-2/1, moist) loam; soft; weak, fine, granular structure; clear, smooth boundary.

B 4 to 20 inches, dark grayish-brown to very dark grayish-brown (10YR 4/2, dry; 3/2, moist) loam with a few pebbles; weak, medium, prismatic and very weak, fine, subangular blocky structure; thin, discontinuous coatings, mainly on prism faces in upper part of layer; clear, wavy boundary.

Cca 20 to 26 inches, grayish-brown and light-gray to dark grayish-brown and gray (2.5Y 5/2, 7/1, dry; 4/2, 6/1, moist) loam with many pebbles that have secondary carbonate coatings on the lower sides; violent effervescence with acid; few, soft carbonate segregations; gradual, wavy boundary.

D 26 to 60 inches, loose sand and gravel; strong effervescence with acid.

The loam A1 horizon is 3 to 6 inches thick. The B horizon is normally made up of loam or coarse clay loam, is 10 to 20 inches thick, and may have a zone of carbonate accumulation in the lower part. In many places the carbonate accumulation occurs in a loam or sandy loam C horizon above the gravelly D horizon. The gravel in the D horizon is variable and contains strata of silt and sand. Fragments of Pierre shale are also common in the gravel. A few areas occasionally have a high water table and have some soils with a claypan.

ORMAN SERIES

The Orman series consists of deep, moderately well drained to well drained soils that occur near the southwestern corner of the county. They belong to the Chestnut great soil group. Their parent material is clay or silty clay alluvium that was deposited either on fans or on the lower parts of slopes. The alluvium consists mainly of material that weathered from Pierre shale, although some of it is from glacial till. Pebbles that occur in some of the soils are from glacial till.

A profile at the SE cor. of sec. 19, T. 109 N., R. 70 W., is as follows:

A1 0 to 3 inches, dark-gray to black (10YR 4/1, dry; 2/1, moist) silt loam or silty clay loam; no color change when material in this or lower layers is crushed; loose; weak, very thin, platy structure; gradual, smooth boundary.

B1 3 to 6 inches, clay loam or silty clay that has colors similar to those of the A1 horizon; slightly hard; weak, fine, prismatic and moderate, very fine, subangular blocky structure; thin, continuous coatings on peds; gradual, irregular boundary.

B21 6 to 9 inches, clay loam or silty clay that has colors similar to those of the A1 horizon; very hard; moderate, medium, prismatic and moderate, very fine, subangular blocky structure; moderate, continuous coatings on peds; gradual, smooth boundary.

B22 9 to 16 inches, clay that has colors similar to those of the A1 horizon; very hard; moderate, medium, prismatic and moderate, very fine, subangular blocky structure; moderate, continuous coatings.

B2ca 16 to 30 inches, grayish-brown to very dark grayish-brown (2.5Y 5/2, dry; 3/2, moist) clay; very hard; moderate, medium, prismatic and moderately weak, very fine, subangular blocky structure; moderate, continuous coatings on prisms; slight effervescence with acid; common carbonate segregations; clear, wavy boundary.

Cca 30 to 52 inches, grayish-brown to very dark grayish-brown (2.5Y-10YR 5/2, dry; 3/2, moist) clay; massive; strong effervescence with acid; common segregations of gypsum crystals; clear, wavy boundary.

Ccs 52 to 60 inches, grayish-brown to olive-brown (2.5Y 5/2, dry; 4/4-3/2, moist) clay; massive; strong effervescence with acid; many segregations of gypsum crystals.

The A horizon is 2 to 4 inches thick, and it normally consists of silty clay or clay. In areas below slopes containing glacial till, the A horizon may be medium to moderately fine textured. In most areas the B horizon is made up of clay, but in some the upper part is moderately fine textured. The clay C horizon normally contains gypsum.

PROMISE SERIES

The soils of the Promise series are well drained, but they have a deep, fine-textured, slowly permeable profile. They belong to the Chestnut great soil group. They occur near the southwestern corner of the county, mostly on slopes along Elm Creek. The upper part of the profile has formed from Pierre shale that was reworked by a glacier. The substratum consists of Pierre shale.

A profile (see table 13 for laboratory data) 185 feet north and 3/16 mile west of the south fork

of the east-west road near the center of sec. 32, T. 111 N., R. 70 W., is as follows:

A1 0 to 3 inches, noncalcareous fine clay that is very dark gray to very dark grayish brown (10YR 3/1.5, dry) with dark-gray (10YR 4/1, dry) coatings; black (10YR 2/1, moist) with black to very dark brown (10YR 2/1.5, moist) coatings; slightly hard to hard when dry, friable when moist; moderate, fine and very fine, subangular blocky structure; thin, discontinuous coatings on the structural units; few, fine, clear and dark quartz grains; clear, smooth boundary.

B21 3 to 10 inches, very weakly calcareous clay that is grayish brown (2.5Y 5/2, dry) with very dark gray to dark-gray (10YR 3.5/1, dry) coatings; very dark grayish brown (2.5Y 3/2, moist) with black to very dark gray (10YR 2.5/1, moist) coatings; hard when dry, friable to firm when moist; moderate, coarse, prismatic structure that breaks to medium, prismatic structure that in turn breaks to moderate, medium, blocky structure; thin, continuous and moderate, discontinuous coatings on the peds; few, fine, clear and dark quartz grains; clear, wavy boundary.

B22 10 to 17 inches, grayish-brown (2.5Y 5/2, dry) and very dark grayish-brown (2.5Y 3/2, moist), very weakly calcareous clay; hard when dry, friable to firm when moist; moderate, very coarse, prismatic structure that breaks to coarse, prismatic structure that in turn breaks to moderate, medium and coarse, blocky structure; thin, continuous and moderate, discontinuous coatings on the primary peds; few, fine, clear and dark quartz grains; clear, wavy boundary.

B23 17 to 28 inches, grayish-brown (2.5Y 5/2, dry) and olive-brown (2.5Y 4/3, moist), very weakly calcareous clay; hard when dry, friable to firm when moist; moderate, very coarse, prismatic structure that breaks to coarse, prismatic structure that in turn breaks to moderate, medium and coarse, blocky structure; moderate, continuous and thick, discontinuous coatings on the primary peds; few, fine, dark and clear quartz grains; gradual, irregular boundary.

C-DB3cacs 28 to 34 inches, grayish-brown (2.5Y 5/2, dry) and olive-brown (2.5Y 4/3, moist), weakly to moderately calcareous clay; hard when dry, friable to firm when moist; few, small, soft carbonate segregations and few, small, soft salt segregations; weak to moderate, coarse, short prisms that break to weak, medium and coarse, blocky structure; thin, continuous and moderate, discontinuous coatings on the primary peds; few, fine, dark and clear quartz grains; gradual, irregular boundary.

Dcacs1 34 to 40 inches, moderately calcareous clay that is white (2.5Y 8/2, dry) with many, fine and medium, distinct, light brownish-gray (2.5Y 6/2, dry) mottles; gray to light gray (2.5Y 6/1, moist) with many, fine and medium, distinct, light olive-brown (2.5Y 5/3, moist) mottles; slightly hard when dry, firm when moist; few, small, soft carbonate segregations; weak, partly weathered, fine, fissile plates of shale with thin, discontinuous coatings on the horizontal faces; common salt masses oriented as bands and seams between the shale plates; few, fine quartz grains; gradual, smooth boundary.

Dcacs2 40 to 50 inches, weakly calcareous clay that is light brownish gray (2.5Y 6/2, dry) with many, fine and medium, distinct, light olive-brown to light yellowish-brown (2.5Y 5.5/4, dry) mottles; olive brown (2.5Y 4/3, moist) with many, fine and medium, distinct, dark-brown to brown (10YR 4/3, moist) mottles; hard when dry, firm when moist; very few, small, soft carbonate segregations; few, small, soft salt segregations; moderate to strong, fine and very fine, fissle plates of shale with thin, discontinuous coatings on the horizontal surfaces; common salt masses oriented as bands or seams between shale plates; few, fine, clear quartz grains; gradual, smooth boundary.

Dcacs3 50 to 60 inches, bands of light brownish-gray and grayish-brown (2.5Y 6/2, 5/2, dry) and olive-brown and dark grayish-brown (2.5Y 4/3, 4/2, moist), weakly calcareous clay; very hard when dry, very firm when moist; very few, small, soft carbonate segregations; very few, small, soft salt segregations; strong, medium, fine and very fine, fissile plates of shale with thin, discontinuous coatings on the horizontal surfaces; common salt masses oriented as bands or seams between shale plates; few, fine, clear quartz grains.

The silty clay or clay A horizon is 2 to 5 inches thick and, in many places, contains a few pebbles. The clay B horizon is 20 to 30 inches thick and generally is underlain by shale. Normally, the B horizon is calcareous and contains gypsum crystals in the lower part.

RABER SERIES

The soils of the Raber series are well drained to moderately well drained. They have a deep, moderately fine textured, moderately permeable profile. These soils belong to the Chestnut great soil group. They occur in gently sloping to steep areas in the southern part of the county. Their parent material is glacial till that may have been mantled by a few inches of loess. In most areas the till consists of clay loam, but in some small areas, it consists of loam.

A profile (see table 13 for laboratory data) 215 feet west and 0.2 mile south of the NE cor. of sec. 16, T. 109 N., R. 69 W., is as follows:

A1 0 to 3 inches, very dark gray to dark grayish-brown (10YR 3.5/1.5, dry) and black (10YR 2/1, moist) silty clay loam; soft to slightly hard when dry, very friable when moist; weak, fine, granular and crumb structure; few, fine, dark and clear quartz grains; clear, smooth boundary.

B2 3 to 10 inches, coarse clay loam that is very dark grayish brown to dark grayish brown (10YR 3.5/2, dry) with very dark gray to dark grayish-brown (10YR 3.5/1.5, dry) coatings; black to very dark brown (10YR 2/1.5, moist) with very dark gray (10YR 3/1, moist) coatings; slightly hard to hard when dry, friable to firm when moist; moderate, medium, prismatic structure that breaks to moderate, fine and medium, subangular blocky structure; thin, continuous and moderate, discontinuous coatings on structural units; few, fine, dark and clear quartz grains; clear, irregular boundary.

B2ca 10 to 14 inches, weakly calcareous clay loam that is gray (2.5Y 5/1, dry) with dark-gray to gray (2.5Y 4.5/1, dry) coatings; very dark grayish brown (2.5Y 3/2, moist) with very dark gray (2.5Y 3/1, moist) coatings; hard when dry, friable to firm when moist; moderate, medium, prismatic structure that breaks to moderate, medium and fine, subangular blocky structure with thin, continuous and moderate, discontinuous coatings; few, medium and small, soft carbonate segregations; few, fine, dark and clear quartz grains; clear, irregular boundary.

B2cacs 14 to 26 inches, weakly to moderately calcareous clay loam that is grayish brown (2.5Y 5/2, dry) with dark-gray (2.5Y 4/1, dry) coatings; dark grayish brown (2.5Y 4/2, moist) with very dark gray (2.5Y 3/1, moist) coatings; hard when dry, friable to firm when moist; weak to moderate, medium, prismatic structure that breaks to weak to moderate, medium, subangular blocky structure; thin, continuous and moderate, discontinuous coatings on the primary peds; many, medium, small and large, soft carbonate segregations; few, soft salt segregations; few, fine, clear and dark quartz grains; few manganese-iron concretions; clear, smooth boundary.

B3cacs 26 to 38 inches, grayish-brown (2.5Y 5/2, dry) and very dark grayish-brown to dark grayish-brown (2.5Y 3.5/2, moist), moderately calcareous clay loam; hard when dry, friable to firm when moist; weak, coarse, prismatic structure that breaks to weak, medium, prismatic structure that in turn breaks to weak, medium, blocky structure; thin, discontinuous coatings on the vertical faces of the primary peds; common, medium, small and large, soft carbonate segregations; few, soft salt segregations; few manganese concretions; few, fine, dark and clear quartz grains; gradual, smooth boundary.

C-Dcacs 38 to 51 inches, moderately calcareous fine clay loam that is grayish brown (2.5Y 5/2, dry) with few, fine, prominent, brownish-yellow (10YR 6/6, dry) mottles; very dark gray (2.5Y 3/1, moist) with few, fine, prominent, yellowish-brown (10YR 5/8, moist) mottles; very hard when dry, firm when moist; massive (structureless) to weak, medium and fine, blocky structure; few, medium, small and large, soft carbonate segregations; few to common, hard carbonate concretions; few, soft salt segregations; some hard secondary carbonate on the undersides of stones and pebbles; few, fine, dark and clear quartz grains; gradual, smooth boundary.

Dca 51 to 60 inches, moderately calcareous fine clay loam that is grayish brown (2.5Y 5/2, dry) with few, fine, prominent, brownish-yellow (10YR 6/6, dry) mottles; olive brown (2.5Y 3/4, moist) with few, fine, prominent, yellowish-brown (10YR 5/8, moist) mottles; very hard when dry, firm when moist; moderate, medium and fine, blocky structure; very few, large, soft carbonate segregations; very few, large, hard carbonate concretions; few, fine, dark and clear quartz grains.

The A horizon of loam or silty clay loam is 2 to 4 inches thick. The B horizon consists of clay loam, is generally 24 to 36 inches thick, and contains, in the lower part, a zone of carbonate accumulation. The segregations of carbonate are one-fourth to one-half inch in diameter. The C horizon is slightly plastic clay loam till that is slightly to moderately saline.

SIOUX SERIES

The Sioux series is made up of deep, well-drained soils that are underlain by gravel within 20 inches of the surface. These soils belong to the Regosol great soil group. They occur in all parts of the county, mainly on stream terraces of glacial age, but also in the uplands. Their parent material was deposited by melt water from glaciers. The upper part consists of loam, and the lower part, of stratified sand, gravel, and silt. Areas of these soils in the uplands may have glacial till in the substratum.

A profile in the center of the NE 1/4 sec. 3, T. 115 N., R. 70 W., is as follows:

A 0 to 4 inches, very dark gray to black (10YR 3/1, dry; 2/1, moist) loam; same color when crushed; slightly hard; moderately weak, very fine, granular structure; clear, smooth boundary.

B2 4 to 11 inches, dark-gray to very dark gray (10YR 4/1, dry; 3/1, moist) coarse loam; same color when crushed; slightly hard; moderately weak, medium, prismatic and very weak, very fine, subangular blocky structure; thin, discontinuous coatings on the prism faces; few carbonate segregations in the non-calcareous matrix; clear, wavy boundary.

B3ca 11 to 15 inches, gray to dark-gray (10YR 5/1, dry; 4/1, moist) coarse loam; gray to very dark grayish brown (10YR 4/1, dry; 3/2-3/1, moist) when crushed; slightly hard; weak, medium, prismatic and very weak, very fine, subangular blocky structure; thin, discontinuous coatings on the prism faces; violent effervescence with acid; common carbonate segregations; this horizon extends into the D horizon in some places.

D1 15 to 30 inches, loose, single-grained sand and gravel; individual sand grains and pebbles are of variegated colors; violent effervescence

with acid; contains some lenses that are mainly shale fragments, and other lenses that are devoid of shale; there are also some unconsolidated iron-rich lenses.

The loam A horizon normally is 3 to 6 inches thick. Most of the Sioux soils in Hand County are typical of the Regosol great soil group; they have a weakly developed loam B horizon, 5 to 15 inches thick. The gravelly and sandy D horizon is generally 12 to 20 inches below the surface.

SPOTTSWOOD SERIES

The soils of the Spottswood series are moderately shallow and are moderately well drained to somewhat poorly drained. They belong to the Chernozem great soil group. Most of the areas are in the northeastern part of the county on low terraces adjacent to small streams. The parent material was deposited by glacial melt water. The gravelly substratum is mantled with about 30 to 60 inches of loam or silt loam.

A profile 0.4 mile north of the SE cor. of sec. 24, T. 112 N., R. 66 W., is as follows:

Ap 0 to 7 inches, very dark gray or black (10YR 3/1-2/1, moist), friable silt loam; moderate, fine, granular structure; abrupt, smooth boundary.

A-B 7 to 14 inches, very dark gray to very dark grayish-brown (10YR 3/1-3/2, moist), friable silt loam; weak, medium, prismatic structure; gradual, smooth boundary.

B2 14 to 19 inches, very dark grayish-brown (10YR 3/2, moist), friable silt loam; moderate, medium, prismatic structure; clear, smooth boundary.

Cca 19 to 26 inches, grayish-brown to light olive-brown (2.5Y 5/3, moist), friable silt loam; massive; violent effervescence with acid; clear, smooth boundary.

C1 26 to 35 inches, light olive-brown (2.5Y 5/4, moist), very friable loam; massive; violent effervescence with acid; clear, smooth boundary.

D1 35 to 60 inches, multicolored, loose, single-grained sand and gravel; strong effervescence with acid.

The A horizon of loam or silt loam is 8 to 12 inches thick. The B horizon of loam, silt loam, or clay loam is 10 to 20 inches thick. The C horizon of sandy loam, loam, silt loam, or clay loam overlies a D horizon made up mainly of gravel.

TETONKA SERIES

The soils of the Tetonka series are deep, but they have a claypan in the subsoil. They belong to the Soloth great soil group. These soils are somewhat poorly drained to poorly drained, and they occur in depressions in all parts of the county. Normally, these depressions are ponded for a short period each year. The upper part of the profile consists of alluvium, and the lower part, of alluvium or till.

A poorly drained profile 144 feet east and 54 feet north of the SW cor. of sec. 33, T. 114 N., R. 69 W., is as follows:

Ap 0 to 6 inches, gray to very dark gray (10YR 5/1-5/2, dry; 3/1-3/2, moist) fine silt loam or loam; same color when crushed; moderately weak, thin, platy structure; clear, smooth boundary.

A2 6 to 12 inches, gray to very dark gray (10YR 5/1, dry; 3/1, moist) silt loam; same color when crushed; few white flecks on the peds; hard; moderately weak, thin, platy structure; few, clear quartz grains; clear, irregular boundary.

A3-B1 12 to 17 inches, gray to very dark gray (10YR 5/1, dry; 3/1, moist) silty clay loam; same color when crushed; hard; moderately weak, fine, subangular blocky structure; very thin, discontinuous coatings on the peds; clear and dark quartz grains; clear, smooth boundary.

B2 17 to 32 inches, dark-gray to very dark gray (10YR 4/1, dry; 3/1, moist) silty clay loam or silty clay; same color when crushed; very hard; moderately weak, medium, prismatic and weak, fine, subangular blocky structure; thin, continuous coatings on the peds; clear and dark quartz grains; clear, smooth boundary.

B3 32 to 43 inches, gray and grayish-brown to very dark gray (2.5Y 5/1, 5/2, dry; 5Y 3/1, moist) silty clay loam; gray to very dark gray (2.5Y 5/1-5/2, dry; 2.5Y 3/1, moist) when crushed; hard; weak, medium, prismatic and very weak, thin, platy structure; very thin, continuous coatings on the peds; clear and dark quartz grains; slight effervescence with acid; clear, smooth boundary.

C1 43 to 53 inches, light-gray and pale-yellow to grayish-brown and light olive-brown (2.5Y 7/4, dry; 5/2, 5/4, moist) coarse silty clay loam; light gray to grayish brown (2.5Y 7/2, dry; 5/2, moist) when crushed; hard; very weak, thin, platy structure; violent effervescence with acid; clear, smooth boundary.

Ccag 53 to 59 inches, light-gray to grayish-brown (2.5Y 7/2, dry; 5/2, moist) coarse silty clay loam; light gray to grayish brown (2.5Y 7/1, dry; 5/2, moist) when crushed; few, fine, indistinct, olive-yellow (2.5Y 6/6) mottles; slightly hard; very weak, thin, platy structure; violent effervescence with acid; common carbonate segregations; clear, smooth boundary.

C3g 59 to 61 inches, light-gray and olive-yellow to grayish-brown and light olive-brown (2.5Y 7/2, 6/8, dry; 5/2, 5/4, moist) loam; light gray to grayish brown (2.5Y 7/2, dry; 5/2-5/4 moist) when crushed; few, fine, indistinct, dark reddish-brown (5YR 3/4) mottles; very weak, thin, platy structure; violent effervescence with acid; few carbonate segregations.

The A1 or Ap horizon is generally a dark-colored silt loam, 4 to 8 inches thick, and, in poorly drained areas, it may be mottled. The A2 horizon consists of gray silt loam, 2 to 10 inches thick,

and is slightly to strongly mottled. The B2 horizon consists of clay loam, silty clay loam, or silty clay. It is dark colored and generally about 20 inches thick.

WESSINGTON SERIES

The soils of the Wessington series are well drained. They belong to the Chernozem great soil group. They are on terraces along streams that carried glacial melt water. The upper part of the profile consists of loam or sandy loam, at least 20 inches thick, and the lower part consists of sand and gravel.

A profile 0.3 mile west of the SE cor. of sec. 11, T. 112 N., R. 66 W., is as follows:

A1 0 to 7 inches, very dark gray (10YR 3/1-2/1, moist), very friable loam; weak, fine, granular structure; clear, smooth boundary.

B2 7 to 16 inches, very dark grayish-brown (10YR 3/2, moist), friable loam; weak, medium, prismatic structure; clear, smooth boundary.

B3 16 to 22 inches, dark grayish-brown (10YR 3/2-4/2, moist), friable loam; weak, medium, prismatic structure; clear, smooth boundary.

Dca 22 to 40 inches, brown (10YR 5/3, moist), loose gravelly loam; single grain (structureless) to weak, granular structure; violent effervescence with acid; clear, smooth boundary.

D 40 to 60 inches, multicolored, loose, moderately calcareous sand and gravel.

The loam or silt loam A horizon is 6 to 10 inches thick. The B horizon consists of loam, silt loam, or sandy loam; has weak, medium, prismatic structure; and is 12 to 24 inches thick. The lower part of the B horizon, or the thin C horizon if present, may be calcareous, but the zone of carbonate accumulation is in the D horizon.

WILLIAMS SERIES

The soils of the Williams series are deep and well drained. They belong to the Chestnut great soil group. The soils are in the northwestern and south-central parts of the county. They have formed mainly from clay loam till, but in small areas, mostly rolling and hilly, they have formed from loam till. In a few areas, the loam that extends from the surface to a depth of 20 to 30 inches was probably deposited by melt water at the edge of the glacier. The Williams soils are thinnest on steep slopes and thickest in nearly level areas.

A profile (see table 13 for laboratory data) 210 feet north and 100 feet east of the W 1/4 cor. of sec. 5, T. 114 N., R. 70 W., is as follows:

A1 0 to 4 inches, very dark grayish-brown (10YR 2.5Y 3.5/2, dry) and black to dark-brown (10YR 2/1.5, moist) loam; soft when dry, friable when moist; weak, thin, platy structure that breaks to weak to moderate, fine, crumb structure; fine, dark and clear quartz grains; clear, smooth boundary.

B21 4 to 8 inches, dark grayish-brown (10YR 4/2, dry) clay loam with dark-gray to dark grayish-brown (10YR 4/1.5, dry) coatings; very dark grayish brown to dark grayish brown (10YR 3.5/2, moist) with very dark gray to very dark grayish-brown (10YR 3/1.5, moist) coatings; slightly hard to hard when dry, friable to firm when moist; moderate, medium, prismatic structure that breaks to fine, prismatic structure that in turn breaks to moderate to strong, medium and fine, subangular blocky structure; thin, continuous and moderate, discontinuous coatings on the peds; few, fine, dark and clear quartz grains; gradual, smooth boundary.

B22 8 to 13 inches, dark grayish-brown (10YR 4/2, dry) clay loam with dark-gray to dark grayish-brown (10YR 4/1.5, dry) coatings; very dark grayish brown to dark grayish brown (10YR 3.5/2, moist) with very dark grayish-brown (10YR 3/2, moist) coatings; hard when dry, friable to firm when moist; moderate to strong, medium, prismatic structure that breaks to fine, prismatic structure that in turn breaks to moderate to strong, medium and fine, subangular blocky structure; thin, continuous and moderate, discontinuous coatings on peds; few, fine, dark and clear quartz grains; clear, wavy boundary.

B3ca 13 to 21 inches, light brownish-gray (2.5Y 6/2, dry), moderately to strongly calcareous clay loam with grayish-brown (2.5Y 5/2, dry) coatings; dark grayish brown to olive brown (2.5Y 4/2.5, moist) with dark grayish-brown (2.5Y 4/2, moist) coatings; hard when dry, friable to firm when moist; weak to moderate, coarse, prismatic structure that breaks to medium, prismatic structure that in turn breaks to weak to moderate, coarse and medium, blocky structure; thin, discontinuous coatings on the peds; many, nearly coalescent, medium and large, soft carbonate segregations; few, fine, dark and clear quartz grains; gradual, wavy boundary.

Ccacs1 21 to 27 inches, moderately to strongly calcareous loam; no matrix color but many, fine, distinct, light-gray and light brownish-gray to light yellowish-brown (N 7/0 and 2.5Y 6/3, dry) mottles and grayish-brown to light olive-brown coatings on the peds; many, fine, distinct, gray and dark grayish-brown to olive-brown (N 5/0 and 2.5Y 4/3, moist) mottles and dark grayish-brown to olive-brown (2.5Y 4/3, moist) coatings; hard when dry, friable to firm when moist; moderate, fine and medium, blocky structure; thin, discontinuous coatings on the peds; common, medium carbonate segregations containing some salts; some secondary carbonates on the underside of the gravel; few, fine, dark and clear quartz grains; gradual, smooth boundary.

Ccacs2 27 to 36 inches, light brownish-gray (2.5Y 6/2, dry), weakly to moderately calcareous loam with many, fine and medium, distinct, gray and light olive-brown (2.5Y 6/1 and 2.5Y 5/4, dry) mottles; dark grayish brown

to olive brown (2.5Y 4/2.5, moist) with many, fine and medium, distinct, gray to grayish-brown and olive-brown to light olive-brown (2.5Y 6/1 and 4.5/4, moist) mottles; hard when dry, friable to firm when moist; moderate, fine and medium, blocky structure; thin, discontinuous coatings on the horizontal faces of peds; common, medium carbonate segregations occur as threads and seams; few, small masses of gypsum crystals; few, fine, dark and clear quartz grains; gradual, smooth boundary.

Ccacs3 36 to 46 inches, light brownish-gray (2.5Y 6/2, dry), weakly to moderately calcareous loam with many, fine and medium, distinct, light-gray and light brownish-gray to light yellowish-brown (N 7/0 and 2.5Y 6/2, dry) mottles; dark grayish brown to olive brown (2.5Y 4/2.5, moist) with many, fine and medium, distinct, gray and olive-brown (N 5/0 and 2.5Y 4/4, moist) mottles; hard when dry, friable to firm when moist; moderate, fine and medium, blocky structure; thin, discontinuous coatings on the horizontal faces of peds; few to common threads and seams of segregated carbonates; common, small masses of gypsum crystals; few, fine, clear quartz grains; gradual, smooth boundary.

C 46 to 60 inches, light brownish-gray to light yellowish-brown (2.5Y 6/3, dry), weakly calcareous loam with many, fine and medium, distinct, gray to light brownish-gray (2.5Y 6/1, dry) mottles; dark grayish brown to olive brown (2.5Y 4/3, moist) with many, fine and medium, distinct, dark-gray to dark grayish-brown (2.5Y 4/1, moist) mottles; hard when dry, friable to firm when moist; weak to moderate, fine and medium, blocky structure; thin, discontinuous coatings on the horizontal faces of peds; few, fine, clear quartz grains.

The loam or silt loam A1 horizon is 3 to 6 inches thick and has granular, crumb, or platy structure. The clay loam B horizon is 17 to 24 inches thick and has mainly prismatic structure. The C horizon consists of clay loam or loam.

ZAHL SERIES

The Zahl series is made up of deep, excessively drained soils that have a thin, dark-colored surface layer. These soils belong to the Regosol great soil group. They are in most parts of the county. They have developed from glacial till or drift on steep slopes where geologic erosion has been rapid. In most areas the parent material is loam or clay loam till, but in many areas it contains gravel and the surface is rocky. Pockets of sand, gravel, and silt occur in the subsoil in many places.

A profile 75 feet south and 0.3 mile east of the NW cor. of sec. 26, T. 116 N., R. 67 W., is as follows:

Ap 0 to 6 inches, dark grayish-brown to very dark grayish-brown (10YR 4/2, dry; 10YR 2.5Y 3/2, moist) loam; dark gray to very dark gray (10YR 4/1, dry; 3/1, moist) when crushed; slightly hard; very weak, very fine, granular structure; slight effervescence with acid; abrupt, smooth boundary.

Bca 6 to 12 inches, light brownish-gray and light-gray to dark grayish-brown (10YR 6/2, 6/1, dry; 4/2, moist) loam; light brownish gray to very dark grayish brown (10YR 6/2-6/1, dry; 4/2, moist) when crushed; slightly hard; very weak, medium, prismatic structure and some very fine, very weak, blocky structure; violent effervescence with acid; common to many carbonate segregations; clear, smooth boundary.

B31 12 to 21 inches, grayish-brown to dark grayish-brown (10YR 5/2-6/2, dry; 4/2, moist) loam or silt loam; light grayish brown to dark grayish brown (10YR 6/2, dry; 4/2, moist) when crushed; slightly hard; very weak, medium, prismatic structure; violent effervescence with acid; common carbonate segregations; clear, smooth boundary.

B32 21 to 29 inches, light brownish-gray to grayish-brown (2.5Y 6/2, dry; 5/2, moist) loam; same color when crushed; slightly hard; very weak, prismatic structure to massive; violent effervescence with acid; common carbonate segregations; clear, smooth boundary.

B-C 29 to 35 inches, variegated light brownish-gray, grayish-brown, and light-gray to dark grayish-brown, grayish-brown, brown, and light brownish-gray (2.5Y 6/2, 5/2, 7/2, dry; 4/2, 5/2, 5/3, 6/2, moist) loam; light brownish gray to grayish brown (2.5Y 6/2, dry; 5/2, moist) when crushed; very weak, prismatic structure to massive; violent effervescence with acid; few carbonate segregations; clear, smooth boundary.

C1 35 to 45 inches, light-gray to light olive-brown (2.5Y 7/2, dry; 5/4, moist) loam; light brownish gray to grayish brown (2.5Y 6/3, dry; 5/2-5/3, moist) when crushed; few, fine, faint, yellowish-red (5YR 4/6) mottles; massive; violent effervescence with acid.

C2 45 to 60 inches, light yellowish-brown to light olive-brown (2.5Y 6/4, dry; 5/4, moist) loam; same color when crushed; few, fine, faint, yellowish-red (5YR 4/6) mottles; massive; violent effervescence with acid.

The loam A horizon is less than 3 inches thick. Most of the Zahl soils in the county have a B horizon of weak, prismatic structure and are not typical Regosols. The C horizon generally is made up of loam or clay loam, but in most areas this layer is very heterogeneous.

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Glossary

Alluvium. Sand, mud, or other fine sediments deposited on land by streams.

Calcareous soil. Soil containing sufficient calcium carbonate (often with magnesium carbonate) to effervesce visibly to the naked eye when treated with dilute hydrochloric acid. Soil alkaline in reaction because it contains free calcium carbonate.

Clay. Mineral soil grains less that 0.002 millimeter (0.000079 inch) in diameter.

Claypan. A dense and heavy soil horizon underlying the upper part of the soil. Claypan is hard when dry and plastic or sticky when wet.

Colluvium. Deposits of soil material accumulated at the base of slopes through the combined influences of water and gravity.

Consistence (soil). The degree of firmness of soil aggregates, or of entire soil horizons, due to the attraction of particles for one another and expressed in terms of resistance of soil to crushing, as loose, compact, friable, crumbly, plastic, soft, firm, hard, and cemented.

Cropland. Land regularly used for crops, except forest crops. Cropland includes rotation pasture, cultivated summer fallow, or other land ordinarily used for crops but temporarily idle.

Fertility. The quality that enables a soil to provide the proper compounds, in proper quantities and balance, for the growth of specified plants when light, temperature, moisture, physical condition of the soil, and other factors are favorable.

Friable. Easily crumbled in the fingers; nonplastic.

Genesis (soil). Mode of origin of the soil. Soil genesis refers particularly to the processes causing the development of the solum from unconsolidated parent materials.

Glacial drift. Rock and earth materials that have been transported and deposited by glacial action. Physically, drift may be divided into four groups: Till, outwash, lacustrine deposits, and ice-contact-stratified drift.

Glacial till. Unsorted clay, silt, sand, and boulders transported and deposited by ice.

Green-manure crop. Any crop grown and plowed under for the purpose of improving soil, especially by adding organic matter.

Horizon. A layer of soil approximately parallel to the land surface, with relatively well-defined characteristics that have been produced through soil-building processes.

Humus. The well-decomposed or more or less stable part of the organic matter of the soil.

Infiltration rate. The rate of the passage of water into the soil surface after the first hour of application. Measured in inches per hour.

Lacustrine deposits. Materials deposited by lake waters.

Leaching. Removal of materials in solution.

Loam soil. Soil having approximately equal amounts of sand, silt, and clay.

Loess. A fine-textured, usually silty deposit laid down by wind.

Massive. A term of structure used to describe soils with large, uniform, cohesive masses and sometimes for those with ill-defined and irregular breakage.

Nutrients, plant. The elements essential to plant growth that may be taken in by plants. They include nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, zinc, and perhaps other elements obtained from the soil; and carbon, hydrogen, and oxygen obtained largely from air and water.

Outwash. Crossbedded gravel, sand, and silt which were deposited by melt water as they flowed from the ice.

Parent material. The unconsolidated mass from which the soil profile developed.

Permeability. That quality of a soil that allows it to transmit water or air.

pH. A term used to indicate the acidity and alkalinity of soils. A pH of 7.0 indicates precise neutrality; large numbers (up to 14.0), alkalinity; and smaller ones (down to 0.0), acidity.

Phase. A subdivision of a soil type that is usually made on the basis of difference in such characteristics as relief, accelerated erosion, or stoniness. Phase variations have practical importance, although they may or may not be reflected in the profile.

Platy. A term of structure used for soils with thin, horizontal plates, usually not well defined.

Prismatic. A prismlike soil structure; the vertical axis longer than the horizontal; vertical faces well defined; without rounded tops. An example is in the B horizon of Agar soil.

Productivity. The capability of a soil to produce a specified plant or sequence of plants under a specified system of management.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

Sand. Rock or mineral fragments with diameters ranging between 0.05 millimeter (0.002 inch) and 2.0 millimeter (0.079 inch). The term sand is also applied to soils containing 85 percent or more of sand.

Series. A group of soils having genetic horizons similar as to differentiating characteristics and arrangement in the soil profile, except for the texture of the surface soil, and developed from a particular type of parent material. A series may include two or more soil types, and these types differ from one another in the texture of the surface soil.

Silt. Small mineral soil grains ranging from 0.05 millimeter (0.002 inch) to 0.002 millimeter (0.000079 inch) in diameter.

Soil textural class. A classification based on the relative proportion of soil separates.

Soil separates. The individual size groups of soil particles, as sand, silt, and clay.

Solum. The upper part of the profile above the parent material. In mature soils this includes the A and B horizons (surface layer and subsoil).

Structure. The aggregates in which the individual soil particles are arranged.

Subgrade (engineering). The basement course of an airport or highway pavement consisting of soil or soil material obtained from the immediate construction area.

Subsoil. That part of the soil profile commonly below plow depth and above the parent material.

Texture. The relative proportion of the various size groups of individual soil grains.

Tilth. The physical condition of a soil in respect to its fitness for the growth of a specified plant.

Topography. The elevations or inequalities of the land surface.

GUIDE TO MAPPING UNITS

[See table 6, p. 15, for the approximate acreage and proportionate extent of the soil; see table 7, p. 45, for estimated average yields for cultivated soils under two levels of management; see table 9, p. 56, table 10, p. 66, table 11, p. 72, and table 12, p. 78, for information about engineering characteristics of the soils]

Map symbol	Mapping unit	Page	Capability unit		Range site	
			Symbol	Page	Name	Page
Ag	Agar association	17	IIc-2	39	Silty	48
BcA	Bonilla-Cresbard loams, nearly level	17	IIc-2	39	Silty	48
BhA	Bonilla-Houdek loams, nearly level	17	IIc-2	39	Silty	48
CaA	Cavour complex, nearly level	18	IVs-91	42	Silty	48
CcA	Cavour-Cresbard silt loams, nearly level	18	IVs-91	42	Silty	48
CeA	Cavour-Eakin complex, nearly level	18	IVs-91	42	Silty	48
ChA	Cavour-Houdek loams, nearly level	18	IVs-91	42	Silty	48
ChB	Cavour-Houdek loams, undulating	18	IVs-91	42	Silty	48
CmA	Cavour-Raber silt loams, nearly level	18	IVs-91	42	Silty	48
CnA	Cavour-Williams loams, nearly level	18	IVs-91	42	Silty	48
CrA	Cresbard-Bonilla loams, nearly level	19	IIIs-9	41	Silty	48
CsA	Cresbard-Cavour silt loams, nearly level	19	IIIs-9	41	Silty	48
EaA	Eakin association, nearly level	19	IIc-2	39	Silty	48
EaB	Eakin association, undulating	19	IIe-2	38	Silty	48
EcA	Eakin-Cavour complex, nearly level	19	IIIs-9	41	Silty	48
EcB	Eakin-Cavour complex, undulating	19	IIIe-9	40	Silty	48
EmA	Eakin-Miranda complex, nearly level	19	IVs-91	42	Silty	48
EmB	Eakin-Miranda complex, undulating	20	IVs-91	42	Silty	48
ErA	Eakin-Raber complex, nearly level	20	IIc-2	39	Silty	48
ErB	Eakin-Raber complex, undulating	20	IIe-2	38	Silty	48
EsA	Exline silty clay, level	20	VIs-91	43	Panspots	50
EtA	Exline complex, nearly level	20	VIs-91	43	Panspots	50
EvA	Exline-Lane silty clay loams, nearly level	20	IVs-91	42	Panspots	50
ExA	Exline-Lane silty clays, level	20	IVs-91	42	Panspots	50
GaA	Gann silt loam, nearly level	21	IIc-2	39	Silty	48
GaB	Gann silt loam, gently sloping	21	IIe-2	38	Silty	48
HaA	Hamerly loam, nearly level	21	IVw-9	42	Silty	48
HbA	Hand loam, nearly level	21	IIc-2	39	Silty	48
HbB	Hand loam, undulating	21	IIe-2	38	Silty	48
HcA	Harriet complex, nearly level	22	IVs-91	42	Panspots	50
HdA	Harriet-LaDelle silty clay loams, nearly level	22	VIs-91	43	Overflow	47
HeA	Harriet-Lane silty clay loams, nearly level	22	VIs-91	43	Overflow	47
Hg	Hilly gravelly land	22	VIe-6	43	Shallow	49
HhA	Houdek loam, nearly level	22	IIc-2	39	Silty	48
HhB	Houdek loam, undulating	22	IIe-2	38	Silty	48
HhC	Houdek loam, rolling	23	IIIe-2	40	Silty	48
HkA	Houdek-Bonilla loams, nearly level	23	IIc-2	39	Silty	48
HkB	Houdek-Bonilla loams, undulating	23	IIe-2	38	Silty	48
HlA	Houdek-Cavour loams, nearly level	23	IIIs-9	41	Silty	48
HlB	Houdek-Cavour loams, undulating	23	IIIe-9	40	Silty	48
HmA	Houdek-Miranda complex, nearly level	23	IVs-91	42	Silty	48
HmB	Houdek-Miranda complex, undulating	23	IVs-91	42	Silty	48
HsB	Houdek-Sioux complex, undulating	23	IIe-2	38	Silty-Shallow Complex	49
HsC	Houdek-Sioux complex, rolling	23	IVe-5	41	Silty-Shallow Complex	49
HsD	Houdek-Sioux complex, hilly	23	VIe-5	43	Silty-Shallow Complex	49
HtD	Houdek-Zahl complex, rolling	23	IIIe-2	40	Silty-Shallow Complex	49
HuD	Houdek-Zahl loams, rolling	23	IIIe-2	40	Silty-Shallow Complex	49
Hv	Hoven silty clay loam	24	VIw-19	43	Overflow Dense Clay	47

Map symbol	Mapping unit	Page	Capability unit Symbol	Page	Range site Name	Page
HyA	Hurley-Orman silty clays, nearly level	24	VIs-91	43	Panspots	50
LaA	LaDelle loam, nearly level	24	IIc-2	39	Silty	48
LbA	LaDelle silt loam, nearly level	24	IIc-2	39	Silty	48
LcA	LaDelle silty clay loam, nearly level	25	IIs-1	39	Clayey	49
LdA	LaDelle silty clay loam, fans, nearly level	25	IIs-1	39	Clayey	49
LeA	LaDelle-Aberdeen silty clay loams, nearly level	25	IIIs-9	41	Clayey	49
LlA	LaDelle-Lamoure silt loams, nearly level	25	IIw-1	39	Silty	48
LmA	Lamoure silty clay loam, nearly level	25	IVw-11	42	Subirrigated	47
LnB	Lane loam, gently sloping	25	IIe-2	38	Silty	48
LoA	Lane silty clay, nearly level	25	IIs-1	39	Clayey	49
LpA	Lane-Exline silty clay loams, nearly level	26	IIIs-9	41	Clayey	49
LrA	Lane-Exline silty clays, level	26	IIIs-9	41	Clayey	49
LsA	Lane-Harriet silty clay loams, nearly level	26	IVs-91	42	Clayey	49
LtD	Lismas-Promise silty clays, hilly	26	VIe-1	43	Shallow	49
Ma	Maddock sandy loam	26	IVe-4	41	Sandy	48
McA	McKenzie clay, level	27	VIs-1	43	Overflow	47
MdA	Miranda complex, nearly level	27	VIs-91	43	Panspots	50
MeA	Miranda-Eakin complex, nearly level	27	VIs-91	43	Panspots	50
MhA	Miranda-Houdek complex, nearly level	27	VIs-91	43	Panspots	50
MhB	Miranda-Houdek complex, undulating	27	VIs-91	43	Panspots	50
MrA	Miranda-Raber complex, nearly level	27	VIs-91	43	Panspots	50
MrB	Miranda-Raber complex, undulating	27	VIs-91	43	Panspots	50
MwA	Miranda-Williams complex, nearly level	28	VIs-91	43	Panspots	50
MyB	Mondamin silty clay loam, gently sloping	28	IIIe-1	40	Clayey	49
OaA	Oahe loam, nearly level	28	IIIs-5	41	Silty	48
OaB	Oahe loam, undulating	28	IIIe-5	40	Silty	48
OhA	Oahe-Sioux loams, nearly level	28	IVs-6	42	Silty-Shallow Complex	49
OhB	Oahe-Sioux loams, undulating	28	IVs-6	42	Silty-Shallow Complex	49
OrA	Orman silty clay, nearly level	29	IIs-1	39	Clayey	49
OrB	Orman silty clay, gently sloping	29	IIIe-1	40	Clayey	49
PrB	Promise silty clay, gently sloping	29	IIIe-1	40	Clayey	49
PrC	Promise silty clay, sloping	29	IVe-1	41	Clayey	49
PrD	Promise silty clay, moderately steep	29	VIe-1	43	Clayey	49
RaA	Raber loam, nearly level	29	IIc-2	39	Silty	48
RaB	Raber loam, undulating	29	IIe-2	38	Silty	48
RaC	Raber loam, rolling	30	IIIe-2	40	Silty	48
RcA	Raber-Cavour loams, nearly level	30	IIIs-9	41	Silty	48
RcB	Raber-Cavour loams, undulating	30	IIIe-9	40	Silty	48
ReA	Raber-Eakin complex, nearly level	30	IIc-2	39	Silty	39
ReB	Raber-Eakin complex, undulating	30	IIe-2	38	Silty	48
ReC	Raber-Eakin complex, rolling	30	IIIe-2	40	Silty	48
RmA	Raber-Miranda complex, nearly level	30	IVs-91	42	Silty	48
RmB	Raber-Miranda complex, undulating	30	IVs-91	42	Silty	48
RpC	Raber-Zahl complex, rolling	30	IIIe-2	40	Silty-Shallow Complex	49
RrC	Raber-Zahl loams, rolling	30	IIIe-2	40	Silty-Shallow Complex	49
Rs	Rolling sandy land	30	IVe-3	41	Shallow	49
Ru	Rough broken land	31	VIe-6	43	Shallow	49
Sa	Saline alluvial land	31	VIw-9	43	Saline Lowland	48
Sm	Sioux loam	31	IVs-6	42	Shallow	49
So	Sioux-Oahe loams	31	IVs-6	42	Shallow-Silty Complex	49
Sw	Sioux-Wessington loams	31	IVs-6	42	Shallow-Silty Complex	49
SxA	Spottswood complex, nearly level	32	IIIs-9	41	Silty	48
SyA	Spottswood loam, nearly level	31	IIIs-5	41	Silty	48

Map symbol	Mapping unit	Page	Capability unit Symbol	Capability unit Page	Range site Name	Range site Page
Tp	Tetonka silt loam, poorly drained	32	Vw-1	42	Overflow	47
Tw	Tetonka silt loam, somewhat poorly drained	32	IVw-9	42	Overflow	47
WeA	Wessington loam, nearly level	32	IIIs-5	41	Silty	48
WeB	Wessington loam, undulating	32	IIIe-5	40	Silty	48
WgA	Wessington-Sioux loams, nearly level	32	IVs-6	42	Silty-Shallow Complex	49
WgB	Wessington-Sioux loams, undulating	32	IVs-6	42	Silty-Shallow Complex	49
WmB	Williams loam, undulating	33	IIe-2	38	Silty	48
WmC	Williams loam, rolling	33	IIIe-2	40	Silty	48
WnA	Williams-Bonilla loams, nearly level	33	IIc-2	39	Silty	48
WnB	Williams-Bonilla loams, undulating	33	IIe-2	38	Silty	48
WpA	Williams-Cavour loams, nearly level	33	IIIs-9	41	Silty	48
WpB	Williams-Cavour loams, undulating	33	IIIe-9	40	Silty	48
WrA	Williams-Eakin complex, undulating	33	IIe-2	38	Silty	48
WsA	Williams-Miranda complex, nearly level	33	IVs-91	42	Silty	48
WsB	Williams-Miranda complex, undulating	33	IVs-91	42	Silty	48
WuB	Williams-Sioux complex, undulating	33	IIe-2	38	Silty-Shallow Complex	49
WuC	Williams-Sioux complex, rolling	34	IVe-5	41	Silty-Shallow Complex	49
WuD	Williams-Sioux complex, hilly	34	VIe-5	43	Silty-Shallow Complex	49
WxC	Williams-Zahl complex, rolling	34	IIIe-2	40	Silty-Shallow Complex	49
WzC	Williams-Zahl loams, rolling	34	IIIe-2	40	Silty-Shallow Complex	49
ZaD	Zahl-Houdek complex, hilly	34	VIe-22	43	Shallow-Silty Complex	49
ZhD	Zahl-Houdek loams, hilly	34	VIe-22	43	Shallow-Silty Complex	49
ZhE	Zahl-Houdek loams, steep	34	VIe-22	43	Shallow-Silty Complex	49
ZmD	Zahl-Raber complex, hilly	34	VIe-22	43	Shallow-Silty Complex	49
ZmE	Zahl-Raber complex, steep	34	VIe-22	43	Shallow-Silty Complex	49
ZrD	Zahl-Raber loams, hilly	34	VIe-22	43	Shallow-Silty Complex	49
ZrE	Zahl-Raber loams, steep	34	VIe-22	43	Shallow-Silty Complex	49
ZsD	Zahl and Sioux soils, hilly	34	VIe-22	43	Shallow	49
ZsE	Zahl and Sioux soils, steep	35	VIe-22	43	Shallow	49
ZxD	Zahl-Williams complex, hilly	35	VIe-22	43	Shallow-Silty Complex	49
ZxE	Zahl-Williams complex, steep	35	VIe-22	43	Shallow-Silty Complex	49
ZyD	Zahl-Williams loams, hilly	35	VIe-22	43	Shallow-Silty Complex	49
ZyE	Zahl-Williams loams, steep	35	VIe-22	43	Shallow-Silty Complex	49

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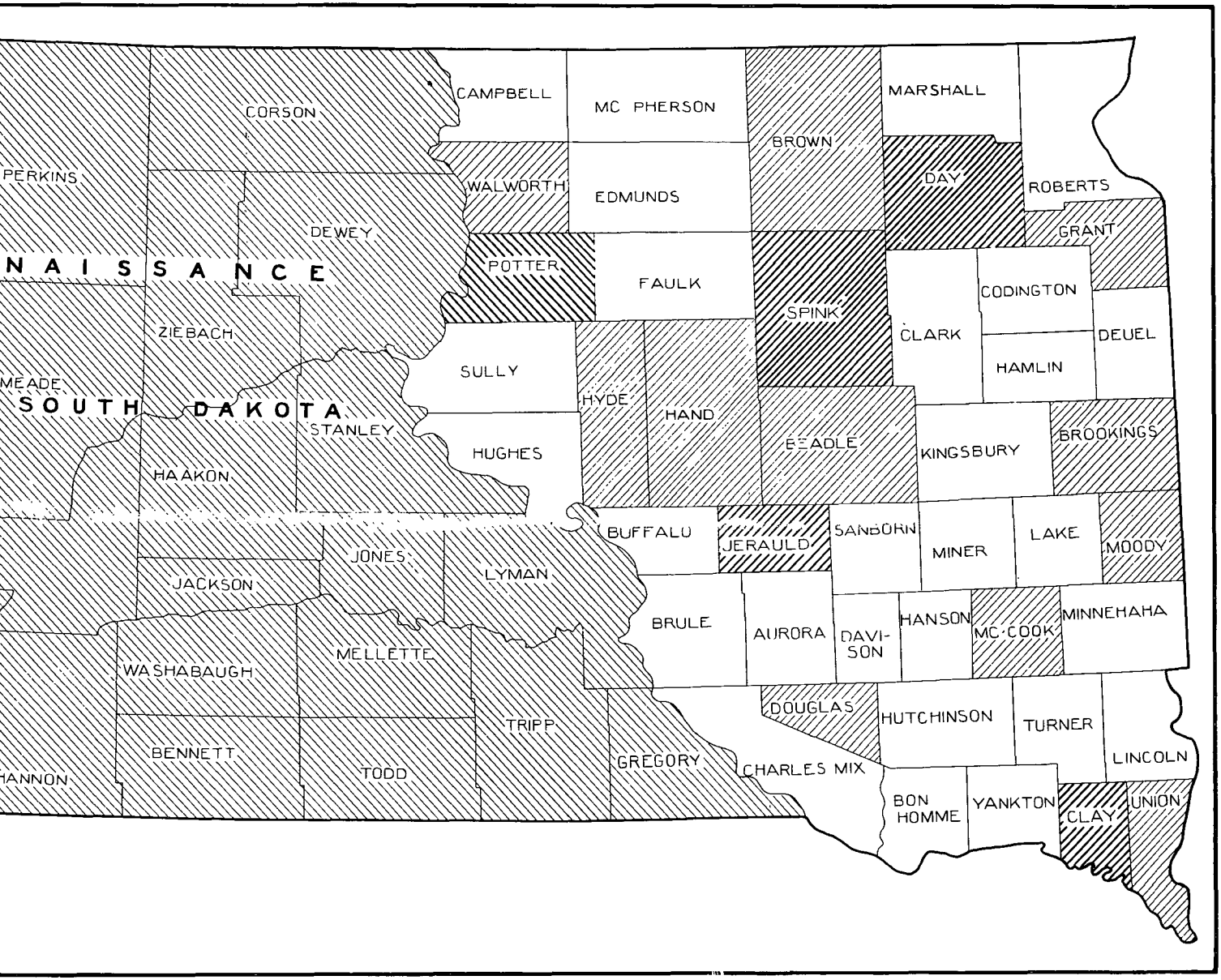

own by shading. Detailed surveys shown by northeast southwest hatching; reconnaissance surveys shown by northwest-southeast hatching; crosshatching h detailed and reconnaissance surveys. Heavy lines in hatching indicate soil surveys published by the South Dakota Agricultural Experiment Station.

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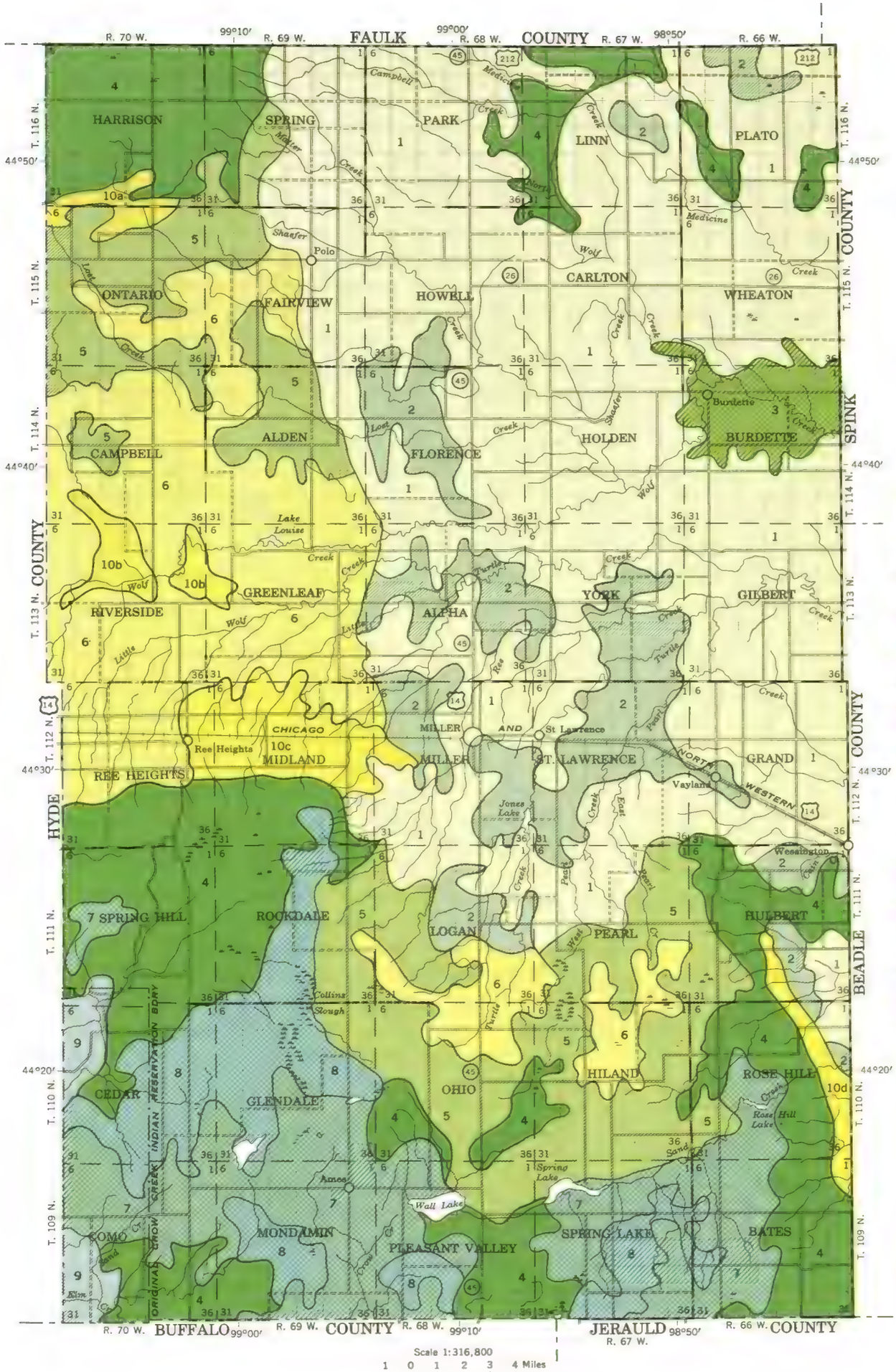


U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
SOUTH DAKOTA STATE COLLEGE,
AGRICULTURAL EXPERIMENT STATION
1962

GENERAL SOIL MAP
HAND COUNTY, SOUTH DAKOTA

N

SOIL ASSOCIATIONS

1 Houdek-Bonilla association: Nearly level to gently undulating loamy soils from glacial till.

2 Houdek-Cavour-Miranda association: Nearly level to gently sloping loamy soils from glacial till; some soils contain claypan.

3 Hand association: Nearly level loamy soils from glacial melt-water deposits.

4 Zahl association: Rolling to hilly soils from mixed materials.

5 Williams-Bonilla association: Nearly level to gently undulating soils from loam or coarse clay loam till.

6 Williams-Cavour-Miranda association: Nearly level to gently undulating loamy soils from clayey till; some soils contain claypan.

7 Raber-Eakin association: Undulating and nearly level clay loam soils from loess and clayey till.

8 Raber-Eakin-Miranda-Cavour association: Undulating and nearly level soils from loess and clayey till; some soils contain claypan.

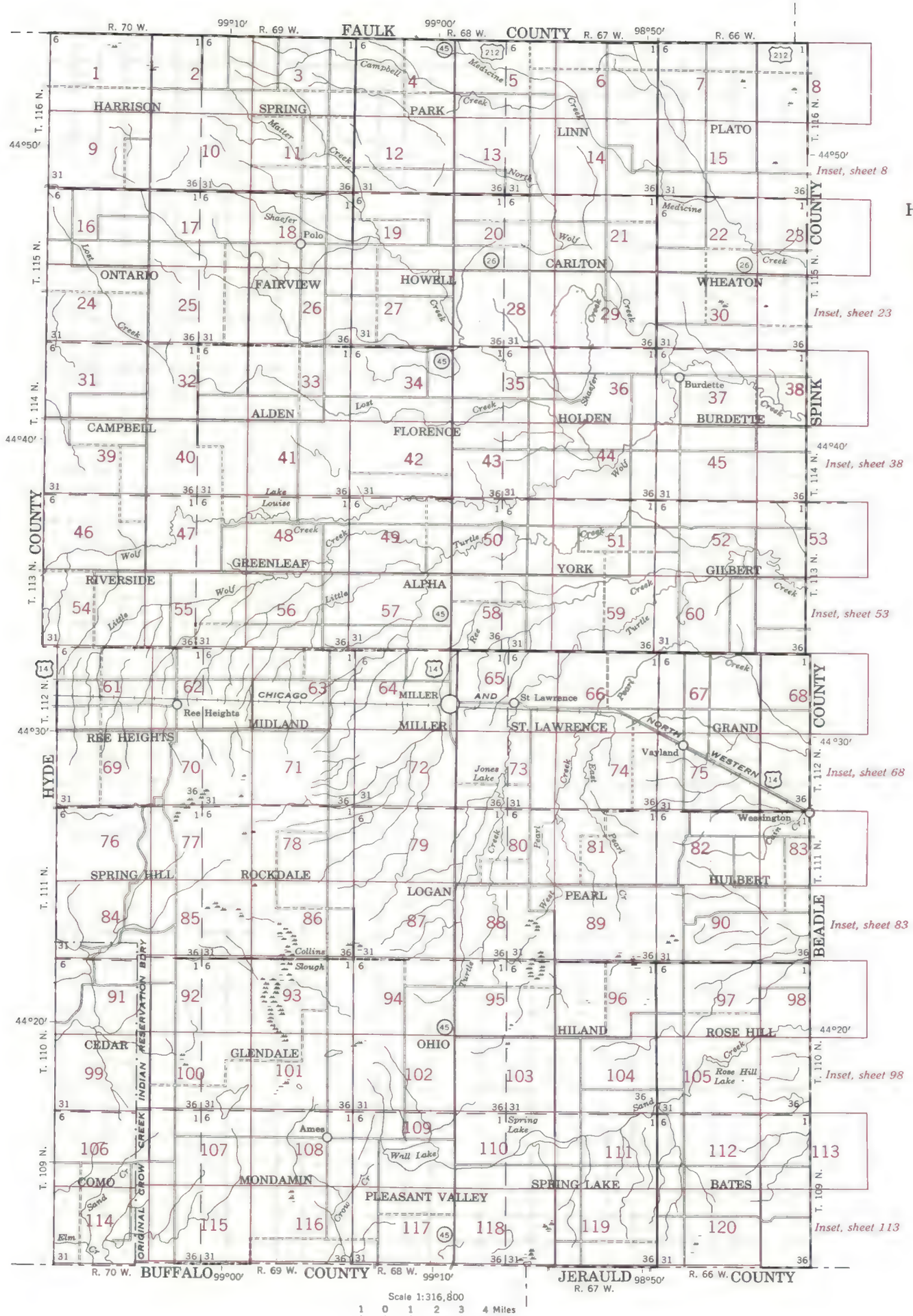
9 Sioux-Promise association: Hilly and steep soils underlain by gravel or shale.

10a Sioux-Oahe association: Gravelly, hilly soils in water-deposited material.

10b McKenzie-Harriet-LaDelle association: Nearly level loamy soils that have silty clay loam or silty clay subsoil; some soils contain claypan.

10c Lane-Exline association: Gently sloping loamy soils and nearly level clayey soils that contain claypan.

10d Lane association: Gently sloping loamy soils from loamy material.



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1962

INDEX TO MAP SHEETS
HAND COUNTY, SOUTH DAKOTA

N

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

HAND COUNTY, SOUTH DAKOTA

SOUTH DAKOTA STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION

SOIL LEGEND

The first capital letter is the initial one of the soil name. A second capital letter, A, B, C, D, or E, shows the slope. Most symbols without a slope letter identify soils or land types that have a range of slope.

SYMBOL	NAME
Ag	Agar association
BcA	Bonilla-Cresbard loams, nearly level
BhA	Bonilla-Houdek loams, nearly level
CaA	Cavour complex, nearly level
CcA	Cavour-Cresbard silt loams, nearly level
CeA	Cavour-Eakin complex, nearly level
ChA	Cavour-Houdek loams, nearly level
ChB	Cavour-Houdek loams, undulating
CmA	Cavour-Raber silt loams, nearly level
CnA	Cavour-Williams loams, nearly level
CrA	Cresbard-Bonilla loams, nearly level
CsA	Cresbard-Cavour silt loams, nearly level
EaA	Eakin association, nearly level
EaB	Eakin association, undulating
EcA	Eakin-Cavour complex, nearly level
EcB	Eakin-Cavour complex, undulating
EmA	Eakin-Miranda complex, nearly level
EmB	Eakin-Miranda complex, undulating
ErA	Eakin-Raber complex, nearly level
ErB	Eakin-Raber complex. undulating
EsA	Exline silty clay, level
EtA	Exline complex, nearly level
EvA	Exline-Lane silty clay loams, nearly level
ExA	Exline-Lane silty clays, level
GaA	Gann silt loam, nearly level
GaB	Gann silt loam, gently sloping
HaA	Hamerly loam, nearly level
HbA	Hand loam, nearly level
HbB	Hand loam, undulating
HcA	Harriet complex, nearly level
HdA	Harriet-LaDelle silty clay loams, nearly level
HeA	Harriet-Lane silty clay loams, nearly level
Hg	Hilly gravelly land
HhA	Houdek loam, nearly level
HhB	Houdek loam, undulating
HhC	Houdek loam, rolling
HkA	Houdek-Bonilla loams, nearly level
HkB	Houdek-Bonilla loams, undulating
HlA	Houdek-Cavour loams, nearly level
HlB	Houdek-Cavour loams, undulating
HmA	Houdek-Miranda complex, nearly level
HmB	Houdek-Miranda complex, undulating
HsB	Houdek-Sioux complex, undulating
HsC	Houdek-Sioux complex, rolling
HsD	Houdek-Sioux complex, hilly
HtD	Houdek-Zahl complex, rolling
HuD	Houdek-Zahl loams, rolling
Hv	Hoven silty clay loam
HyA	Hurley-Orman silty clays, nearly level
LaA	LaDelle loam, nearly level
LbA	LaDelle silt loam, nearly level
LcA	LaDelle silty clay loam, nearly level
LdA	LaDelle silty clay loam, fans, nearly level
LeA	LaDelle-Aberdeen silty clay loams, nearly level
LlA	LaDelle-Lamoure silt loams, nearly level
LmA	Lamoure silty clay loam, nearly level
LnB	Lane loam, gently sloping
LoA	Lane silty clay, nearly level
LpA	Lane-Exline silty clay loams, nearly level
LrA	Lane-Exline silty clays, level
LsA	Lane-Harriet silty clay loams, nearly level
LtD	Lismas-Promise silty clays, hilly
Ma	Maddock sandy loam
McA	McKenzie clay, level
MdA	Miranda complex, nearly level
MeA	Miranda-Eakin complex, nearly level
MhA	Miranda-Houdek complex, nearly level
MhB	Miranda-Houdek complex, undulating
MrA	Miranda-Raber complex, nearly level
MrB	Miranda-Raber complex, undulating
MwA	Miranda-Williams complex, nearly level
MyB	Mondamin silty clay loam, gently sloping
OaA	Oahe loam, nearly level
OaB	Oahe loam, undulating
OhA	Oahe-Sioux loams, nearly level
OhB	Oahe-Sioux loams, undulating
OrA	Orman silty clay, nearly level
OrB	Orman silty clay, gently sloping
PrB	Promise silty clay, gently sloping
PrC	Promise silty clay, sloping
PrD	Promise silty clay, moderately steep
RaA	Raber loam, nearly level
RaB	Raber loam, undulating
RaC	Raber loam, rolling
RcA	Raber-Cavour loams, nearly level
RcB	Raber-Cavour loams, undulating
ReA	Raber-Eakin complex, nearly level
ReB	Raber-Eakin complex, undulating
ReC	Raber-Eakin complex, rolling
RmA	Raber-Miranda complex, nearly level
RmB	Raber-Miranda complex, undulating
RpC	Raber-Zahl complex, rolling
RrC	Raber-Zahl loams, rolling
Rs	Rolling sandy land
Ru	Rough broken land
Sa	Saline alluvial land
Sm	Sioux loam
So	Sioux-Oahe loams
Sw	Sioux-Wessington loams
SxA	Spottswood complex, nearly level
SyA	Spottswood loam, nearly level
Tp	Tetonka silt loam, poorly drained
Tw	Tetonka silt loam, somewhat poorly drained
WeA	Wessington loam, nearly level
WeB	Wessington loam, undulating
WgA	Wessington-Sioux loams, nearly level
WgB	Wessington-Sioux loams, undulating
WmB	Williams loam, undulating
WmC	Williams loam, rolling
WnA	Williams-Bonilla loams, nearly level
WnB	Williams-Bonilla loams, undulating
WpA	Williams-Cavour loams, nearly level
WpB	Williams-Cavour loams, undulating
WrA	Williams-Eakin complex, undulating
WsA	Williams-Miranda complex, nearly level
WsB	Williams-Miranda complex, undulating
WuB	Williams-Sioux complex, undulating
WuC	Williams-Sioux complex, rolling
WuD	Williams-Sioux complex, hilly
WxC	Williams-Zahl complex, rolling
WzC	Williams-Zahl loams, rolling
ZaD	Zahl-Houdek complex, hilly
ZhD	Zahl-Houdek loams, hilly
ZhE	Zahl-Houdek loams, steep
ZmD	Zahl-Raber complex, hilly
ZmE	Zahl-Raber complex, steep
ZrD	Zahl-Raber loams, hilly
ZrE	Zahl-Raber loams, steep
ZsD	Zahl and Sioux soils, hilly
ZsE	Zahl and Sioux soils, steep
ZxD	Zahl-Williams complex, hilly
ZxE	Zahl-Williams complex, steep
ZyD	Zahl-Williams loams, hilly
ZyE	Zahl-Williams loams, steep

Soil map constructed 1962 by Cartographic Division, Soil Conservation Service, USDA, from 1957 aerial photographs. Controlled mosaic based on North Dakota plane coordinate system, north zone, Lambert conformal conic projection, 1927 North American datum.

CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads
- Dual
- Good motor
- Poor motor
- Trail

Highway markers
- National Interstate
- U. S.
- State

Railroads
- Single track
- Multiple track
- Abandoned

Bridges and crossings
- Road
- Trail, foot
- Railroad
- Ferries
- Ford
- Grade
- R. R. over
- R. R. under
- Tunnel

Buildings
- School
- Church
- Station

Mines and Quarries
- Mine dump
- Pits, gravel or other

Power lines

Pipe lines

Cemeteries

Dams

Levees

Tanks

Oil wells

Windmills

BOUNDARIES

- National or state
- County
- Township, U. S.
- Section line, corner
- Reservation
- Land grant
- Township, civil

DRAINAGE

Streams
- Perennial
- Intermittent, unclass.

Canals and ditches (CANAL / DITCH)

Lakes and ponds
- Perennial
- Intermittent

Wells (flowing)

Springs

Marsh

Wet spot

Alluvial fan

RELIEF

Escarpments
- Bedrock
- Other

Prominent peaks

Depressions (Large / Small)

SOIL SURVEY DATA

- Soil boundary and symbol (Dx)
- Gravel
- Stones
- Rock outcrops
- Chert fragments
- Clay spot
- Sand spot
- Gumbo or scabby spot
- Made land
- Severely eroded spot
- Blowout, wind erosion
- Gullies
- Wind erosion, moderate
- Wind erosion, severe
- Wind hummock
- Overblown soil
- Gravelly hills

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 1

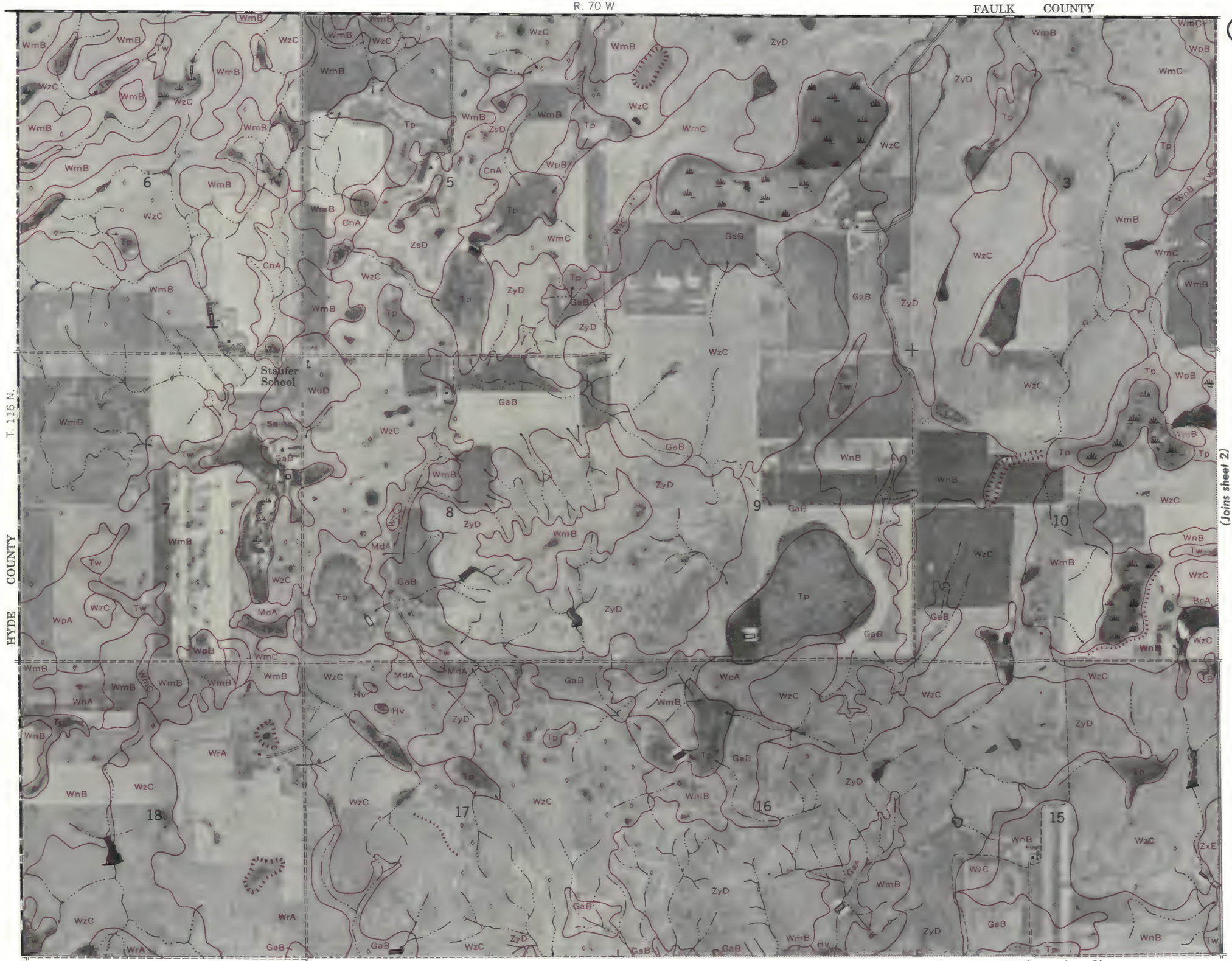
R. 70 W

FAULK COUNTY

HYDE COUNTY

T. 116 N.

Staufer School



(Joins sheet 2)

(Joins sheet 9)

N

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the South Dakota State College, Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 2

R. 70 W. | R. 69 W.

FAULK COUNTY

T. 116 N.

(2)

N

Progress School

Palmer School

Miller Creek

(Joins sheet 1)

(Joins sheet 3)

(Joins sheet 10)

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 3

R. 69 W.

FAULK COUNTY

T. 116 N.

(Joins sheet 2)

(Joins sheet 4)

(Joins sheet 11)

Orient

ORIENT-PRAIRIEVIEW CEMETERY

Campbell Creek

N

3

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Scale 1:20 000

0 ½ 1 Mile

0 5000 Feet

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 4

FAULK COUNTY

R. 68 W.

T. 116 N.

N

(Joins sheet 3)

(Joins sheet 5)

(Joins sheet 12)

Campbell Creek

Dienslake Lake

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 5

R. 68 W. | R. 67 W.

FAULK COUNTY

5

N

T. 116 N.

(Joins sheet 4)

(Joins sheet 6)

(Joins sheet 13)

Medicine Creek

Campbell Creek

GRAVEL PILES

GRAVEL PIT

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

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Range, township, and section corners shown on this map are indefinite.

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 6

FAULK COUNTY

R. 67 W.

6

N

T. 116 N

Rockham

Meridional Creek

Campbell Creek

(Joins sheet 5)

(Joins sheet 7)

(Joins sheet 14)

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 7

R. 66 W.

FAULK COUNTY

7

N

T. 116 N.

Rockham

(Joins sheet 6)

(Joins sheet 8)

(Joins sheet 15)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

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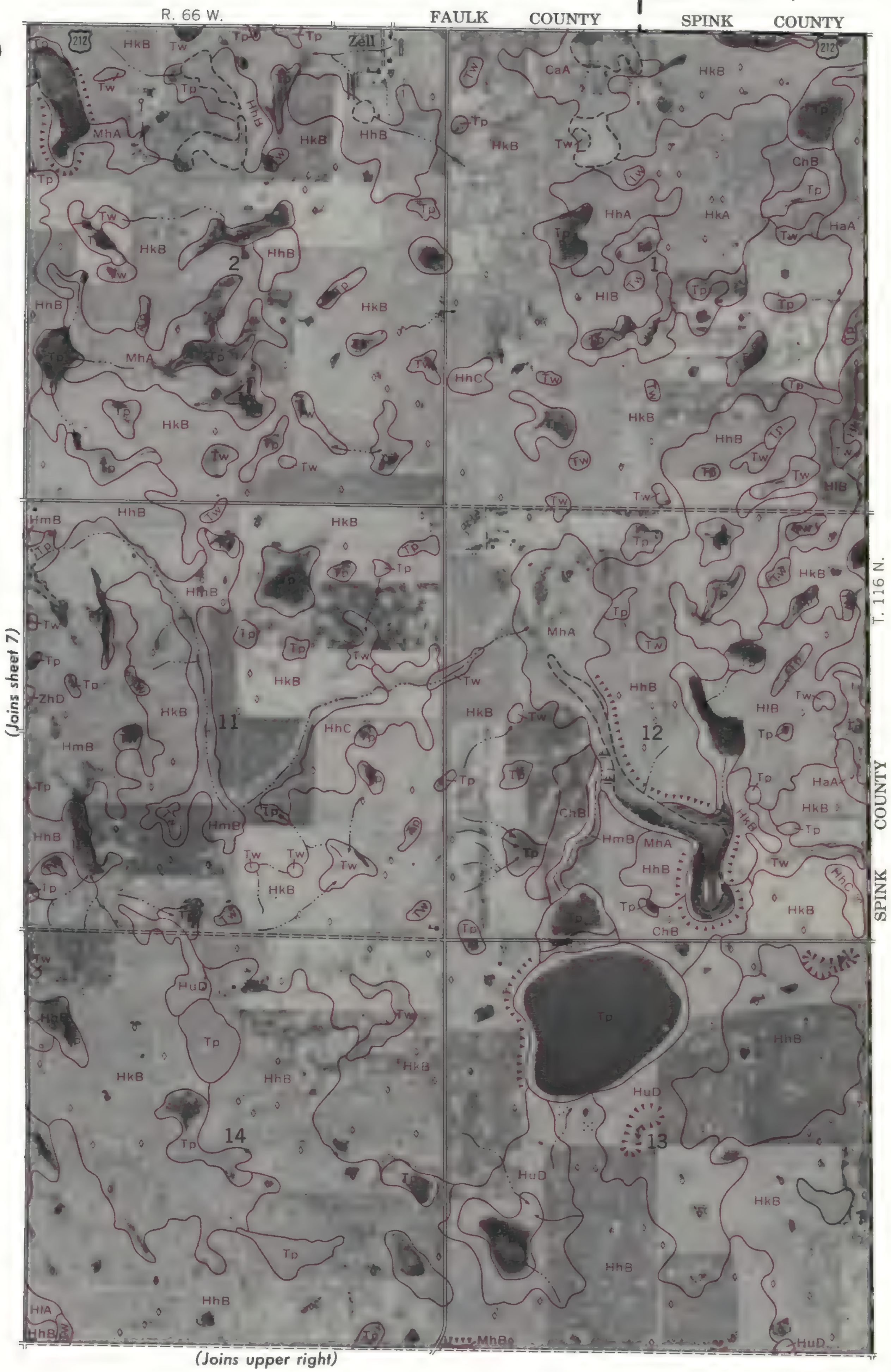
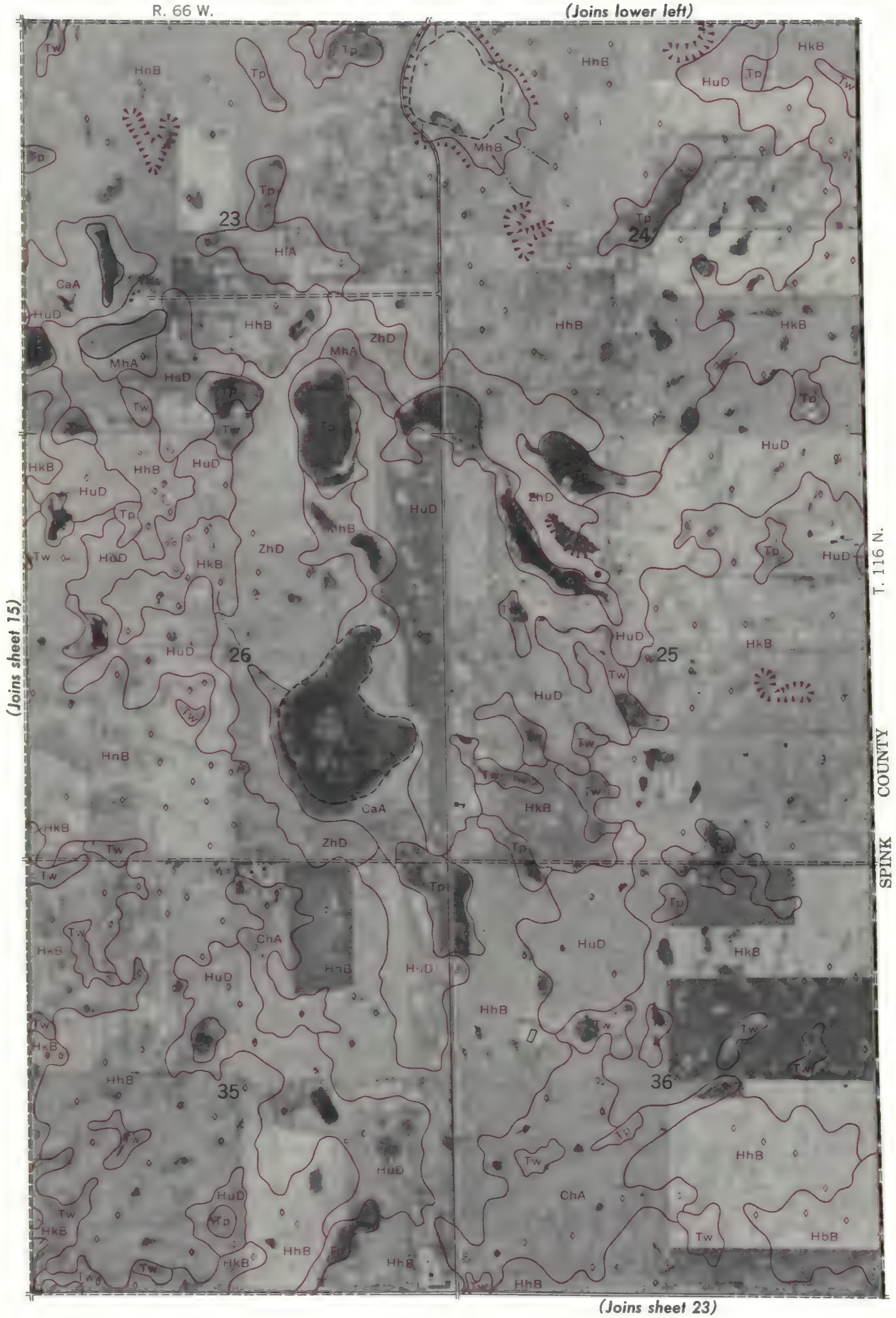
Range, township, and section corners shown on this map are indefinite.

8

N





0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 9

R. 70 W.

(Joins sheet 1)

9

N

T. 116 N.

HYDE COUNTY

Hillview School

19 20 21 22

29 28 27

30 31 32 33 34

(Joins sheet 10)

(Joins sheet 16)

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

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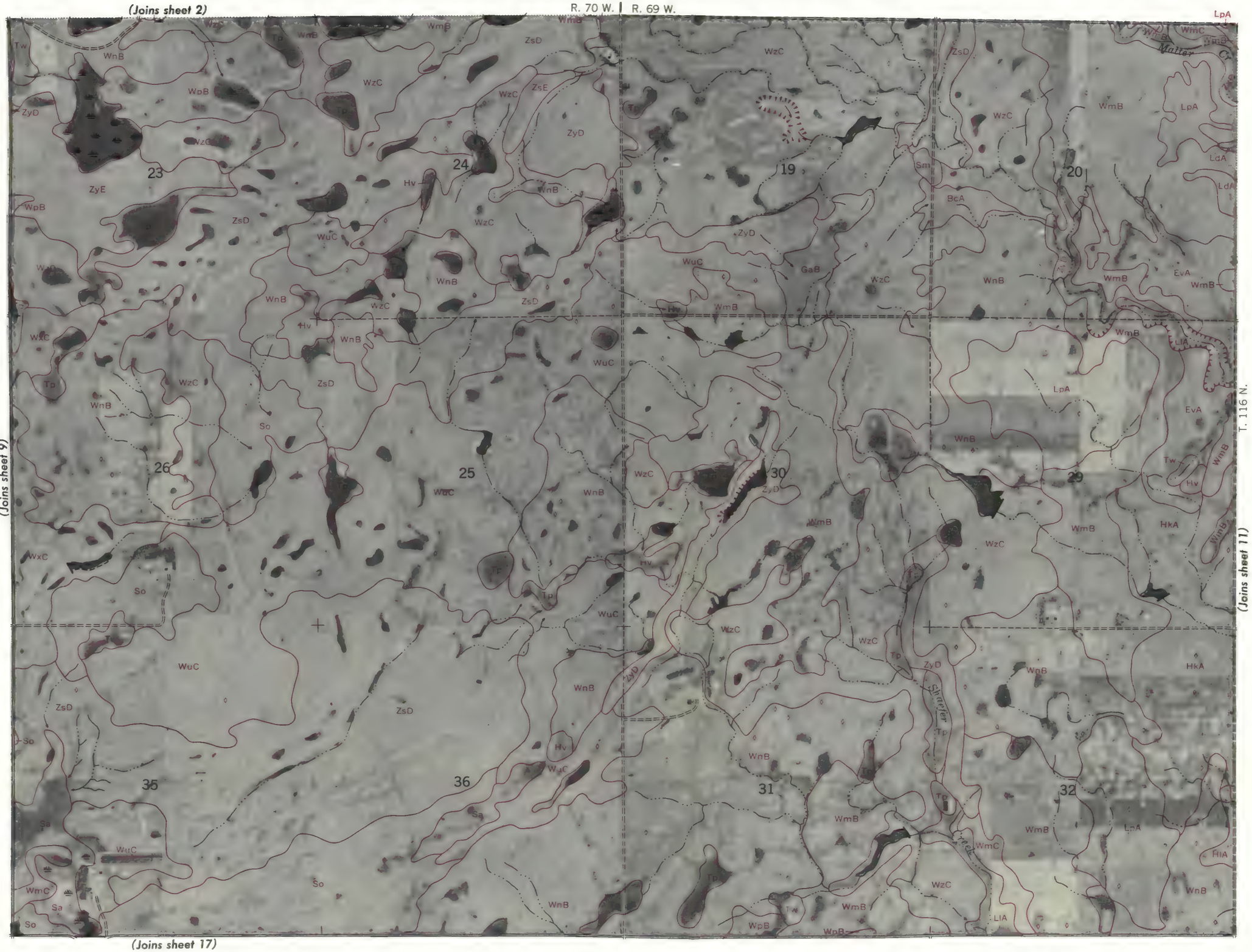
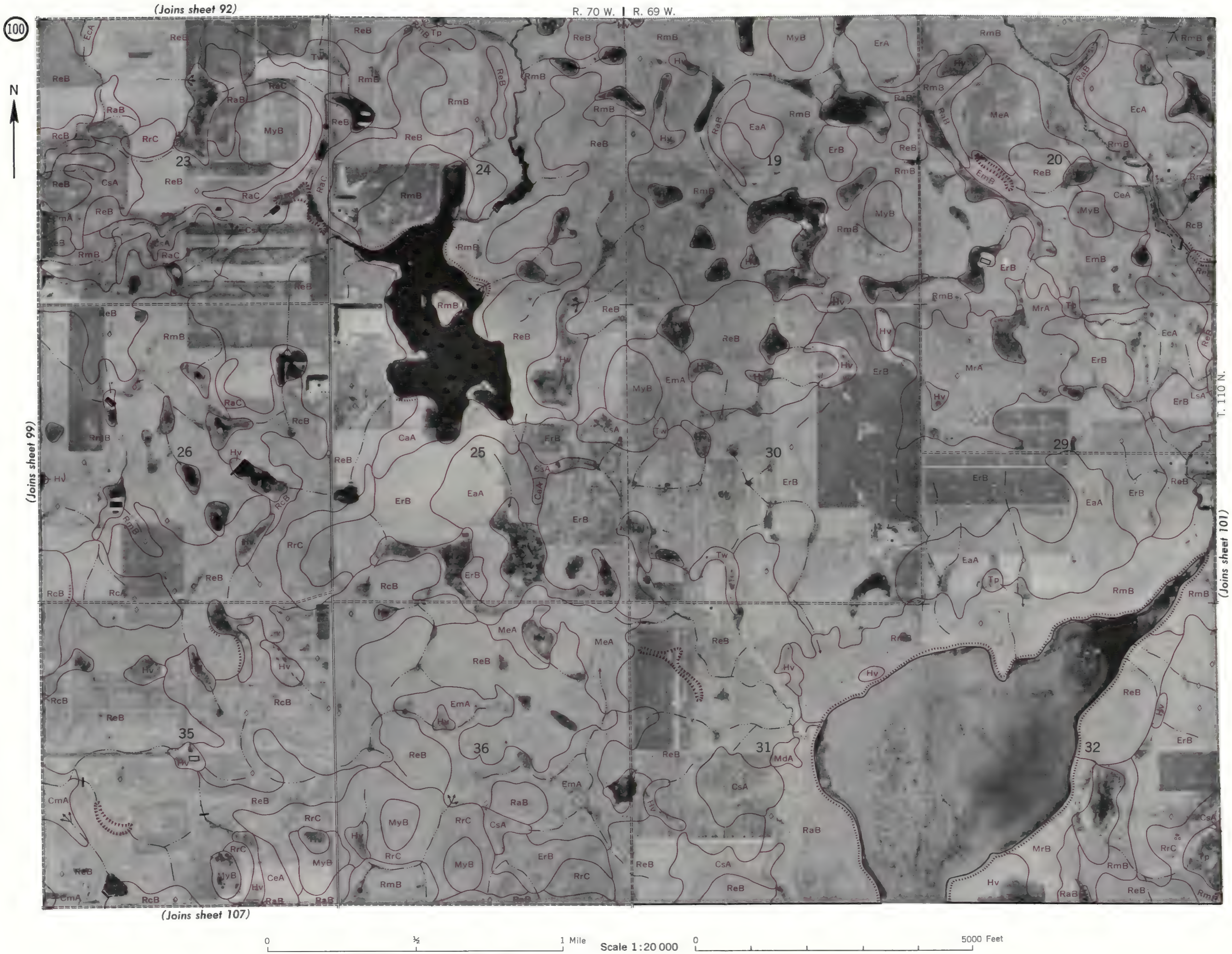
HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 10




100
(Joins sheet 92)
R. 70 W. | R. 69 W.
N
(Joins sheet 99)
(Joins sheet 101)
(Joins sheet 107)
T. 110 N.
23
24
19
20
26
25
30
29
35
36
31
32
0
½
1 Mile
Scale 1:20 000
0
5000 Feet

R. 69 W.

(Joins sheet 93)

101

N

T. 110 N.

COLLINS SLOUGH

21 22 23 24

28 27 26 25

33 34 35 36

(Joins sheet 100)

(Joins sheet 102)

(Joins sheet 108)

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the South Dakota State College, Agricultural Experiment Station.

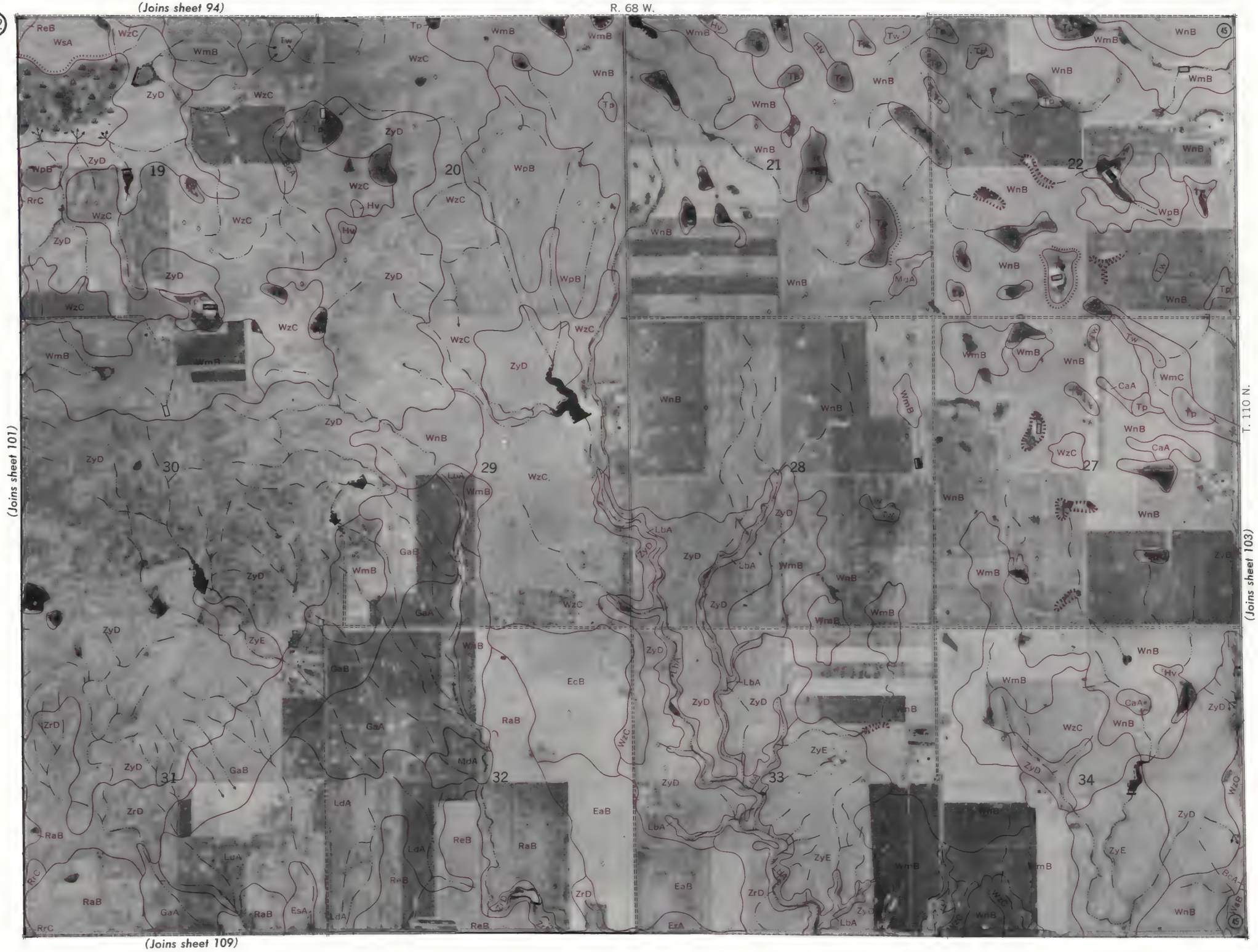
Range, township, and section corners shown on this map are indefinite.

(Joins sheet 94)

R. 68 W.

102

N



(Joins sheet 101)

(Joins sheet 103)

T. 110 N.

(Joins sheet 109)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

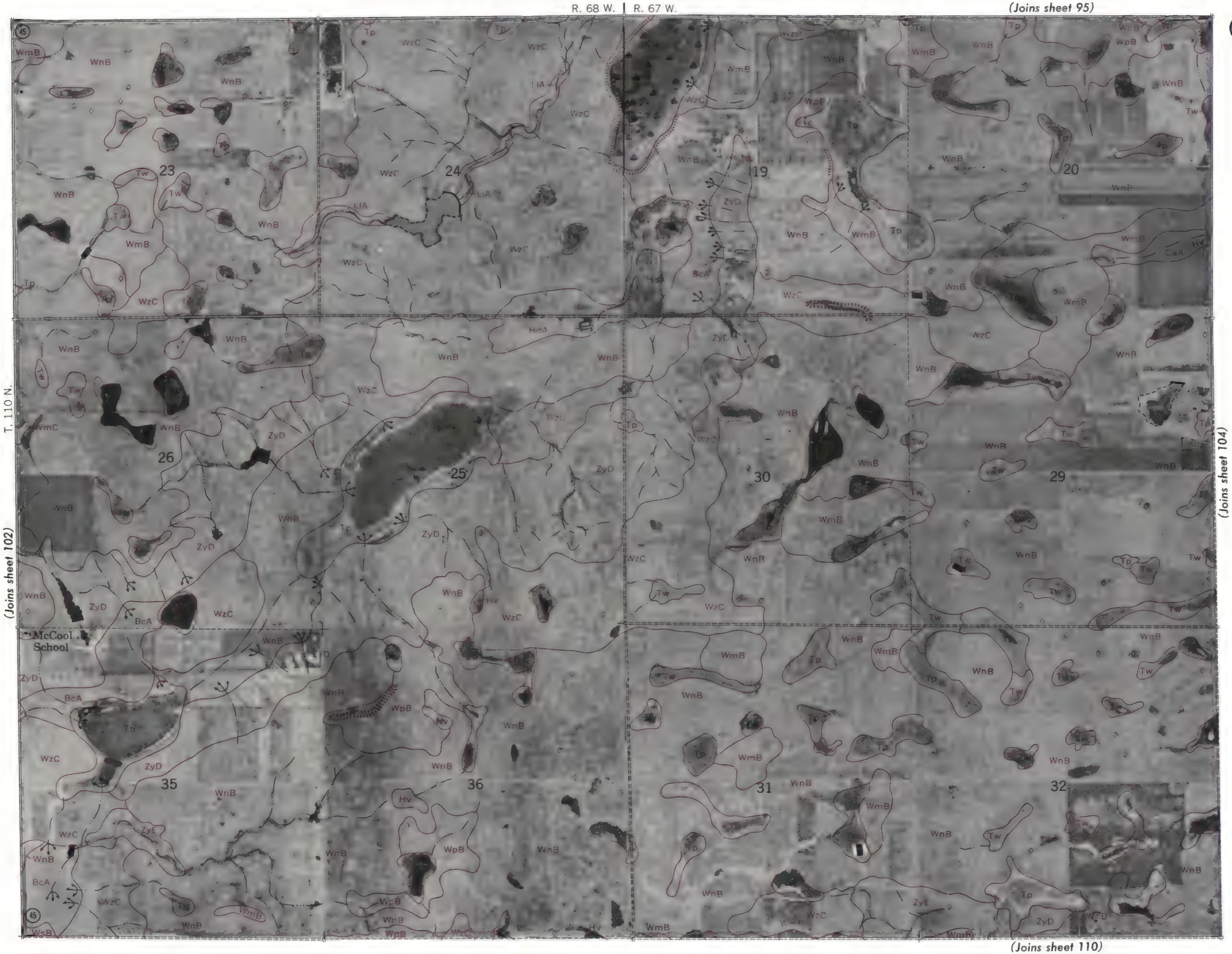
R. 68 W. | R. 67 W.

(Joins sheet 95)

103

N

T. 110 N.



(Joins sheet 102)

(Joins sheet 104)

(Joins sheet 110)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

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Range, township, and section corners shown on this map are indefinite.

(Joins sheet 96)

R. 67 W.

104

N

T. 110 N.

(Joins sheet 103)

(Joins sheet 105)

21 22 23 24

28 27 26 25

33 34 35 36

Keck School

(Joins sheet 111)

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the South Dakota State College, Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

R. 66 W.

T. 110 N.

(Joins sheet 97)

(Joins sheet 104)

(Joins sheet 98)

(Joins sheet 112)

105

N

Rose Hill Church

GRAVEL PIT

Rose Hill Lake

Sand Creek

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

106

N

(Joins sheet 99)

R. 70 W.

HYDE COUNTY

T. 109 N.

INDIAN RESERVATION BOUNDARY

ORIGINAL CROW CREEK

Sand Creek

(Joins sheet 107)

(Joins sheet 114)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

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Range, township, and section corners shown on this map are indefinite.

R. 70 W. | R. 69 W.

T. 109 N.

(Joins sheet 100)

(Joins sheet 106)

(Joins sheet 108)

(Joins sheet 115)

N

0 ½ 1 Mile Scale 1:20,000 0 5000 Feet

(108)

N

R. 69 W.

T. 109 N.

(Joins sheet 101)

(Joins sheet 107)

(Joins sheet 109)

(Joins sheet 116)

Ames

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

R. 69 W.

(Joins sheet 102)

109

N

T. 109 N.

(Joins sheet 108)

(Joins sheet 110)

(Joins sheet 117)

GRAVEL PIT

WALL LAKE

Kintigh School

Creek

Crow

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

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HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 11

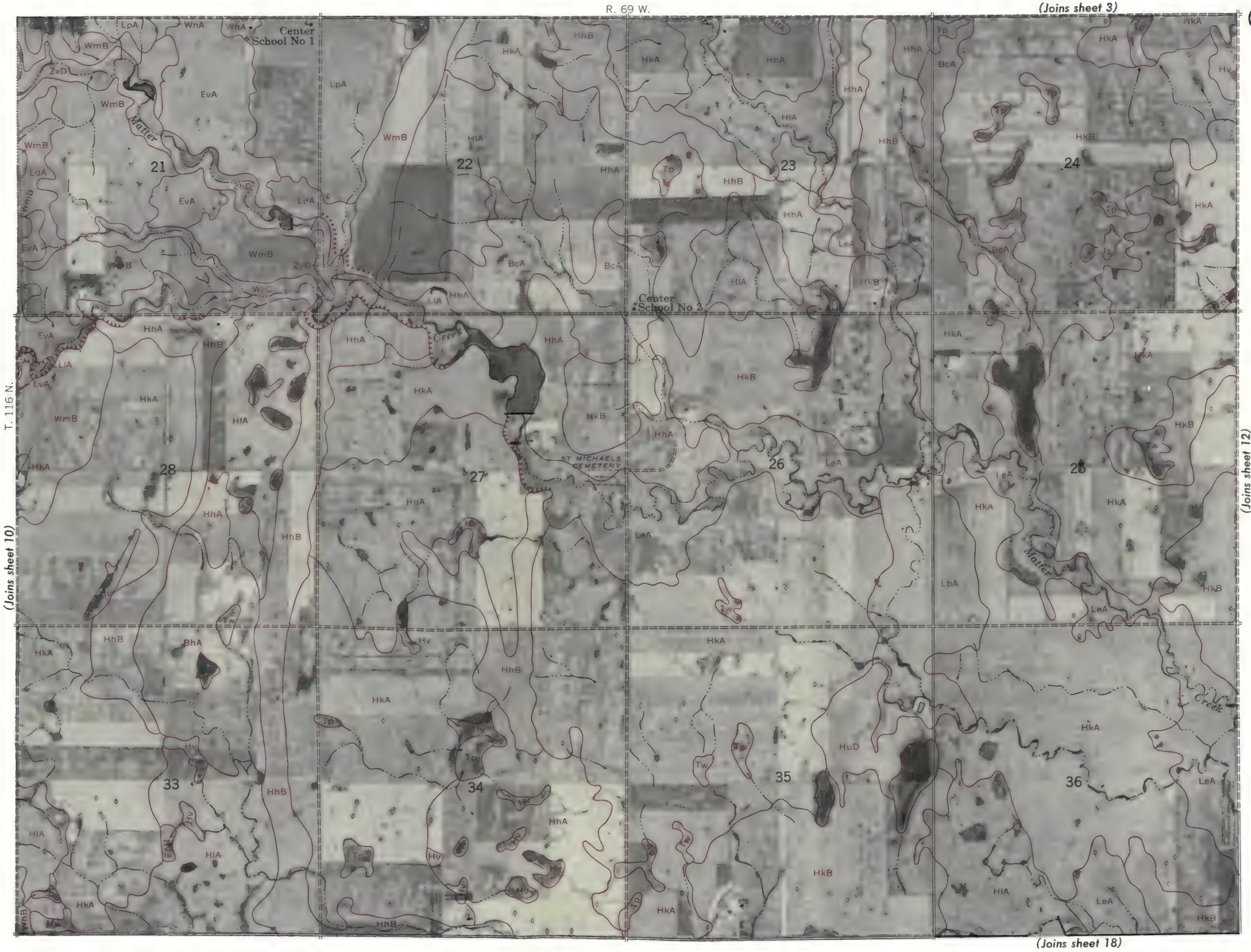
R. 69 W.

(Joins sheet 3)

11

N

T. 116 N.



(Joins sheet 10)

(Joins sheet 12)

(Joins sheet 18)

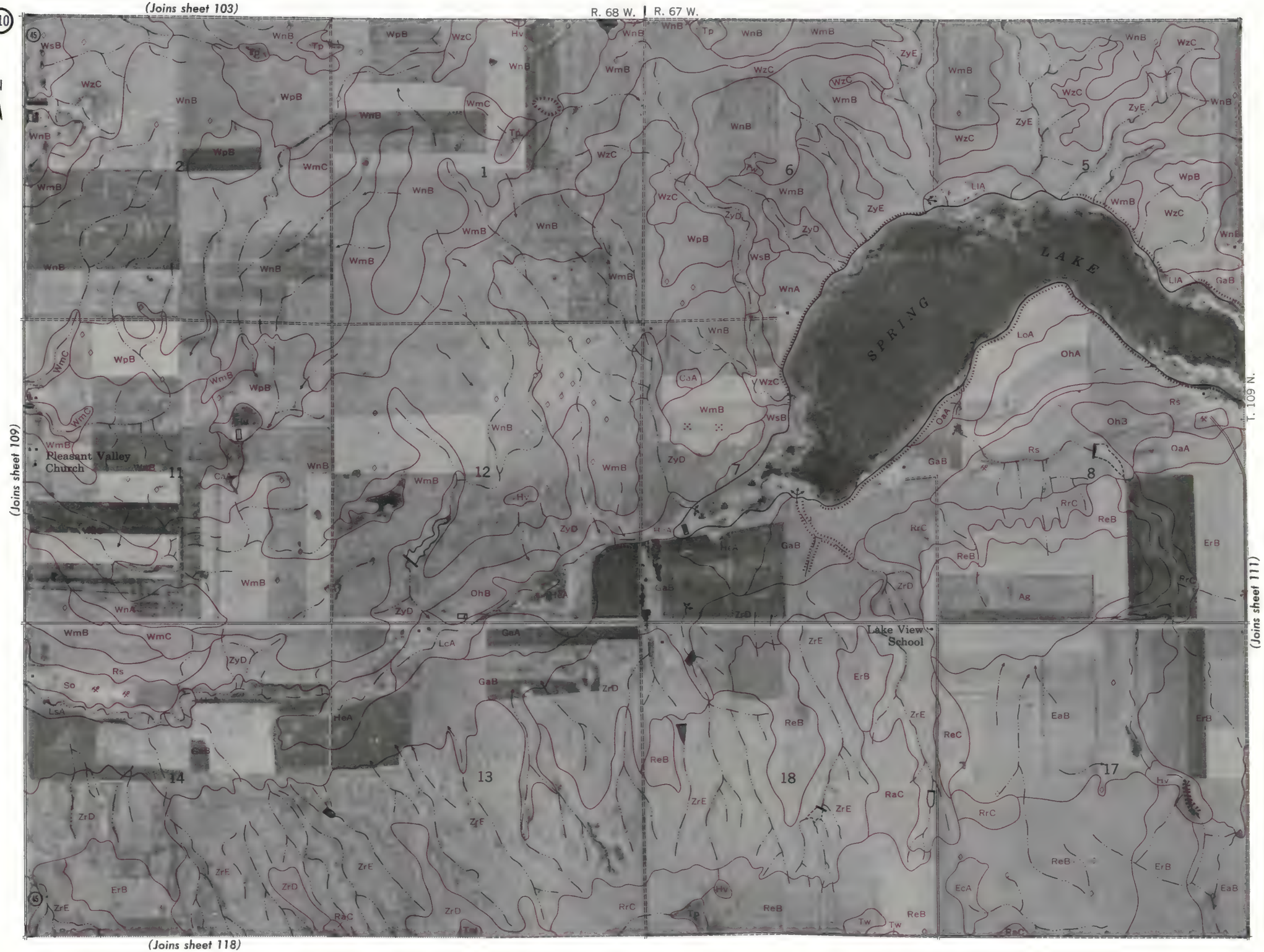
0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the South Dakota State College, Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.



0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the South Dakota State College, Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

R. 67 W.

(Joins sheet 104)

111

N

T. 109 N.

(Joins sheet 110)

(Joins sheet 112)

(Joins sheet 119)

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

(112)

(Joins sheet 105)

R. 66 W.

N

T. 109 N.

(Joins sheet 111)

(Joins sheet 113)

(Joins sheet 120)

Domsch School

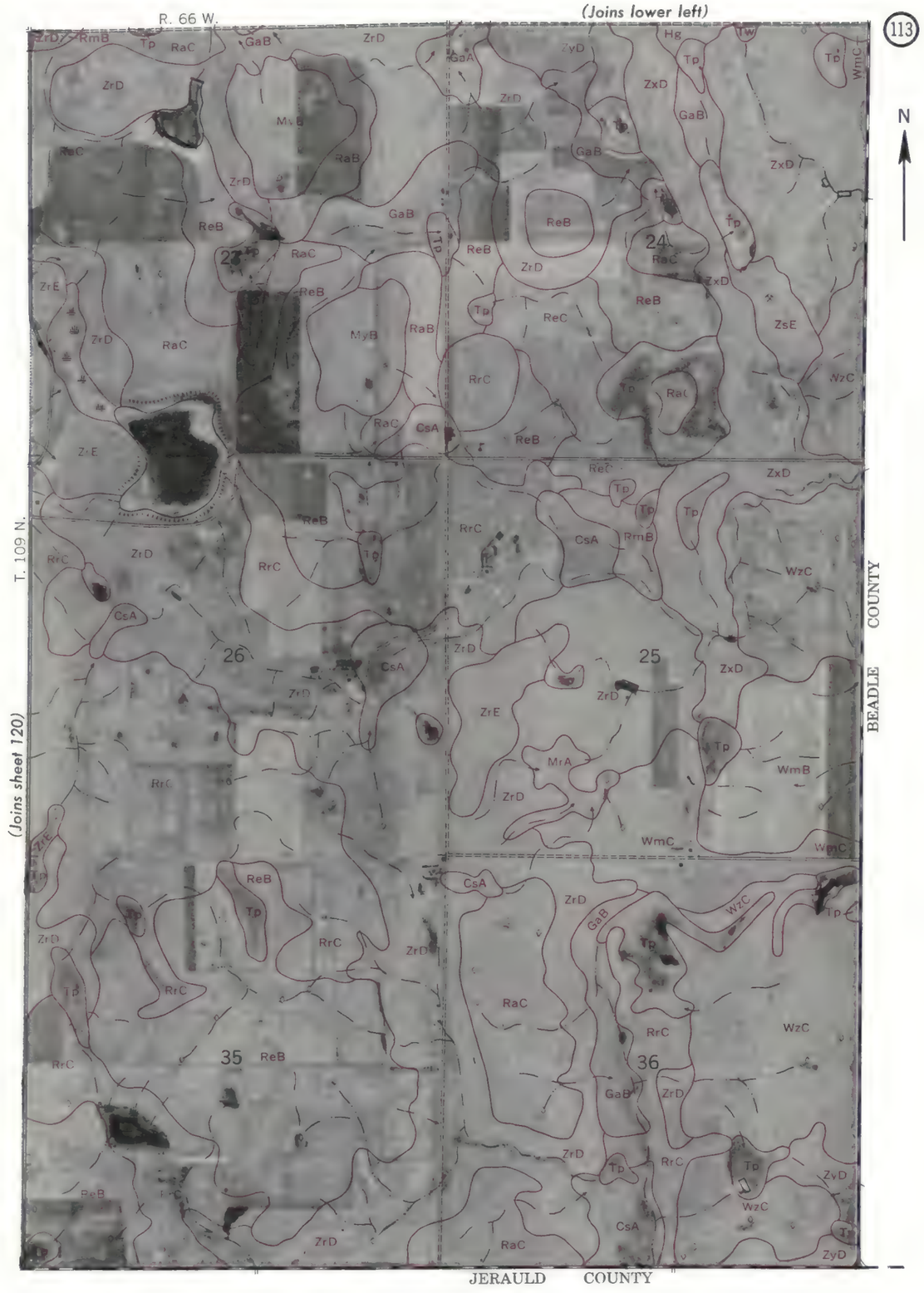
0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the South Dakota State College, Agricultural Experiment Station.

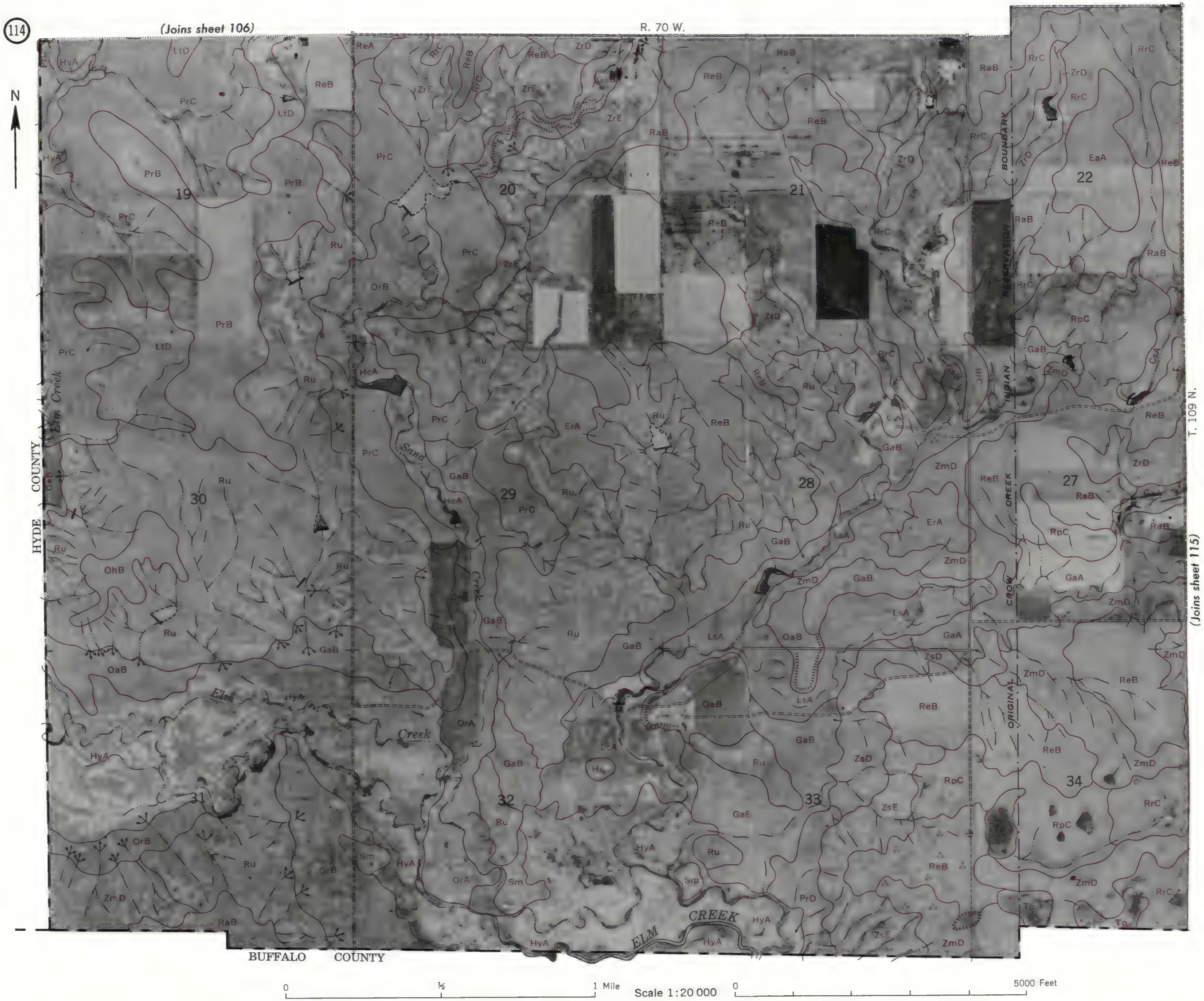
Range, township, and section corners shown on this map are indefinite.



0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet


114
(Joins sheet 106)
R. 70 W.
N
T. 109 N.
(Joins sheet 115)
HYDE COUNTY
BUFFALO COUNTY
INDIAN RESERVATION BOUNDARY
ORIGINAL CROW CREEK
Elm Creek
Sand Creek
ELM CREEK
19
20
21
22
27
28
29
30
31
32
33
34
0
½
1 Mile
Scale 1:20 000
0
5000 Feet

This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the South Dakota State College, Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

R. 70 W. | R. 69 W.

(Joins sheet 107)

115

N

T. 109 N.

(Joins sheet 114)

(Joins sheet 116)

BUFFALO COUNTY

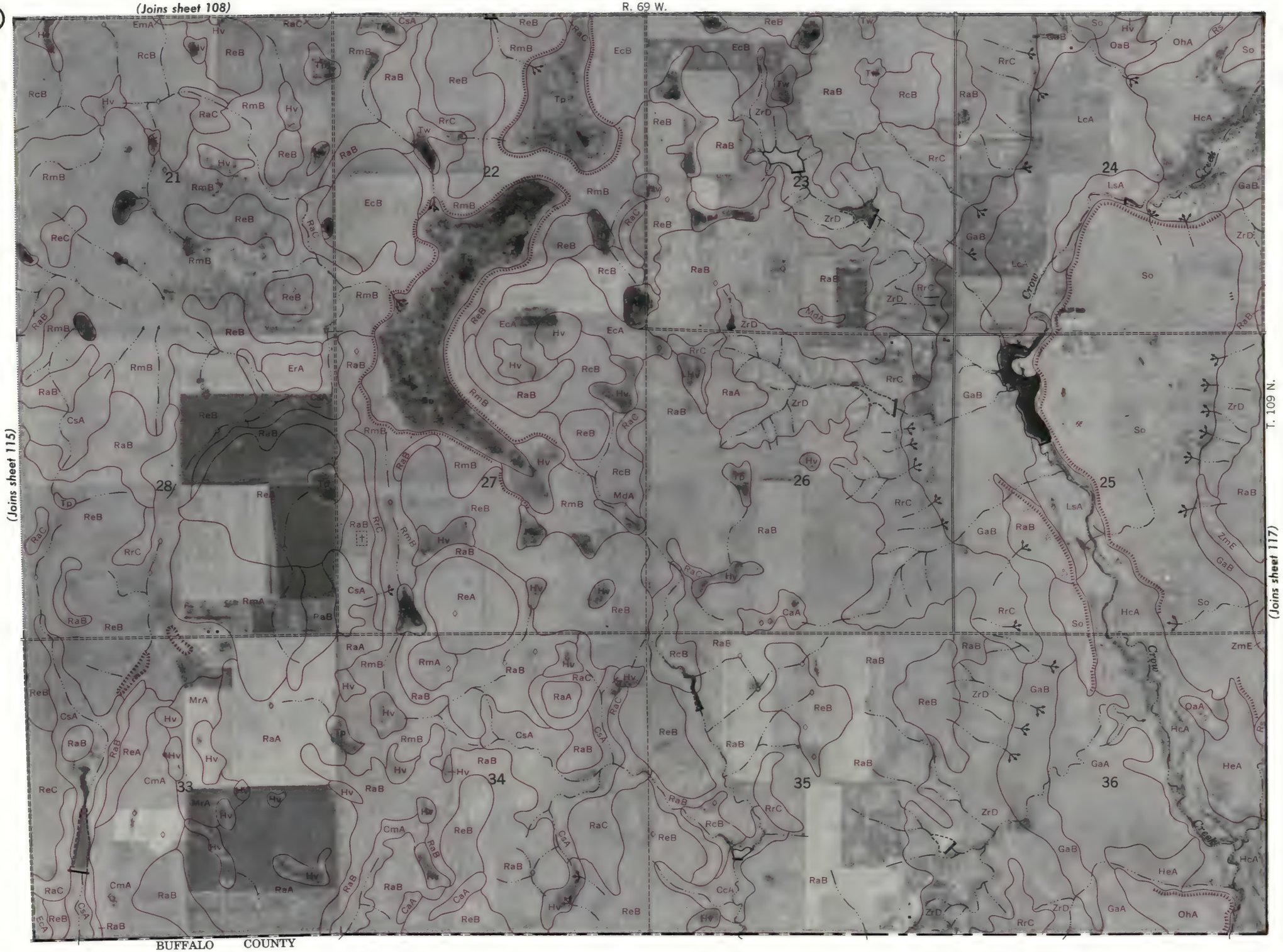
0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

(116)

(Joins sheet 108)

R. 69 W.

N



(Joins sheet 115)

(Joins sheet 117)

T. 109 N.

BUFFALO COUNTY

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 117

R. 68 W.

(Joins sheet 109)

117

N

T. 109 N.

(Joins sheet 116)

(Joins sheet 118)

BUFFALO COUNTY

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the South Dakota State College, Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

(Joins sheet 110)

R. 68 W. | R. 67 W.

T. 109 N.

(Joins sheet 117)

(Joins sheet 119)

BUFFALO COUNTY | JERAULD COUNTY

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

R. 67 W.

(Joins sheet 111)

119

N

T. 109 N.

(Joins sheet 118)

(Joins sheet 120)

JERAULD COUNTY

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the South Dakota State College, Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.


(12)
(Joins sheet 4)
R. 68 W.
N
19
20
21
22
30
29
28
27
31
32
33
34
Central School
Matter Creek
Costigan Slough
T. 116 N.
(Joins sheet 11)
(Joins sheet 13)
(Joins sheet 19)
(45)
HkA
HkB
HhA
HhB
LeA
LbA
BcA
CnA
MhA
HlB
HlA
HtD
ZsD
BhA
Tp
Tw
0
½
1 Mile
Scale 1:20 000
0
5000 Feet

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 120

(120)

(Joins sheet 112)

R. 66 W.

N

T. 109 N.

(Joins sheet 119)

(Joins inset, sheet 113)

JERAULD COUNTY

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 13

R. 68 W. | R. 67 W.

(Joins sheet 5)

13

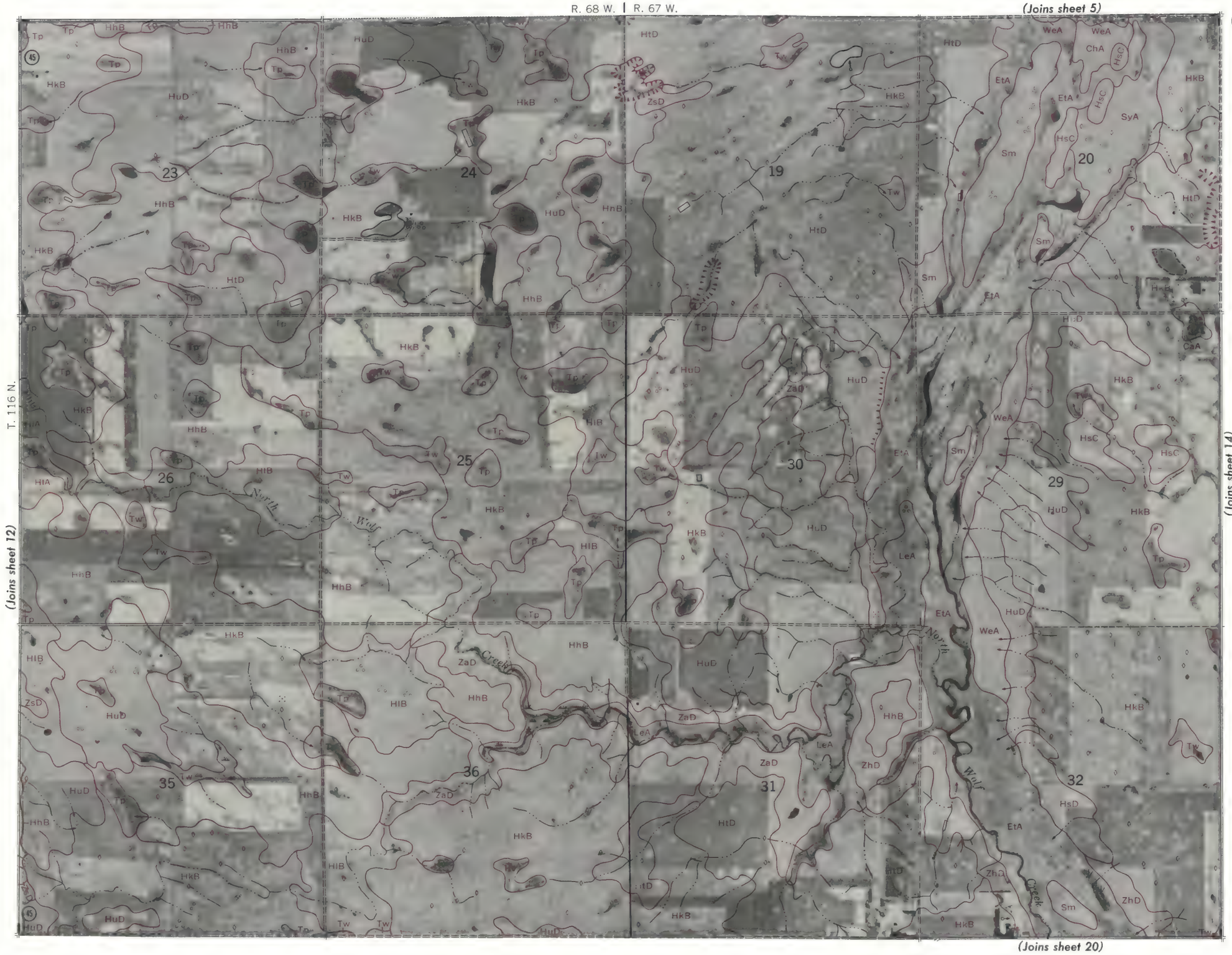
N

T. 116 N.

(Joins sheet 12)

(Joins sheet 14)

(Joins sheet 20)



0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

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Range, township, and section corners shown on this map are indefinite.

(14)

(Joins sheet 6)

R. 67 W.

N

T. 116 N.

(Joins sheet 13)

(Joins sheet 15)

(Joins sheet 21)

21 22 23 24 25 26 27 28 33 34 35 36

Medicine Creek

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 15

R. 66 W.

(Joins sheet 7)

15

N

T. 116 N.

(Joins sheet 14)

(Joins sheet 8)

(Joins sheet 22)

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

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Range, township, and section corners shown on this map are indefinite.

16

(Joins sheet 9)

R. 70 W.

N

HYDE COUNTY

T. 115 N.

Ontario School

Loon Creek

(Joins sheet 17)

(Joins sheet 24)

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 17

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the South Dakota State College, Agricultural Experiment Station.

• Range, township, and section corners shown on this map are indefinite.

18

(Joins sheet 11)

R. 69 W.

N

(Joins sheet 17)

(Joins sheet 19)

T. 115 N.

Shaefer Creek

CALVARY CEMETERY

Pol

(Joins sheet 26)

0 ½ 1 Mile

Scale 1:20 000

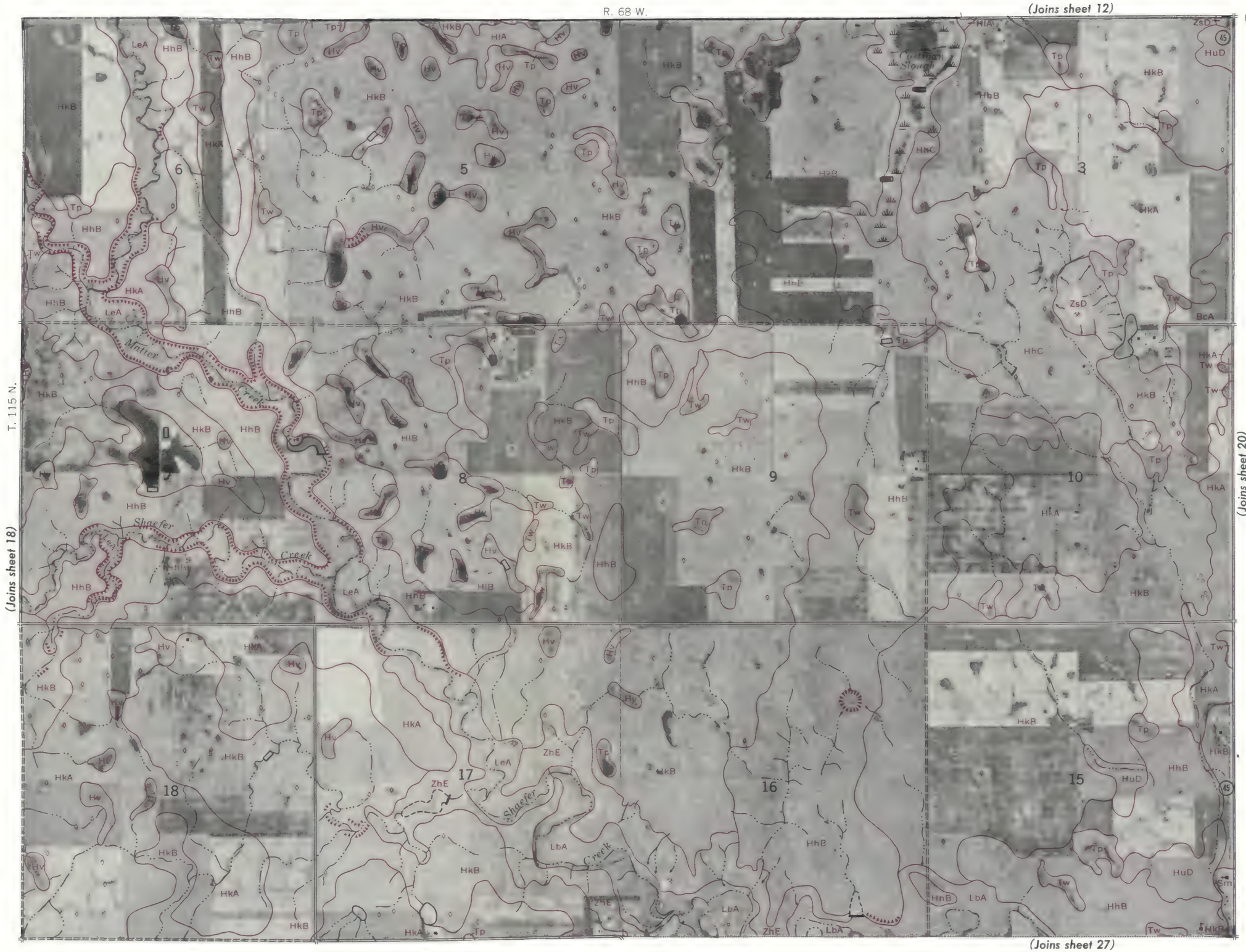
0 5000 Feet

This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the South Dakota State College, Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

R. 68 W.

T. 115 N.



0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

(Joins sheet 13)

R. 68 W. | R. 67 W.

T. 115 N.

(Joins sheet 19)

(Joins sheet 21)

(Joins sheet 28)

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

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Range, township, and section corners shown on this map are indefinite.

R. 67 W.

T. 115 N.

(Joins sheet 14)

(Joins sheet 20)

(Joins sheet 22)

(Joins sheet 29)

N

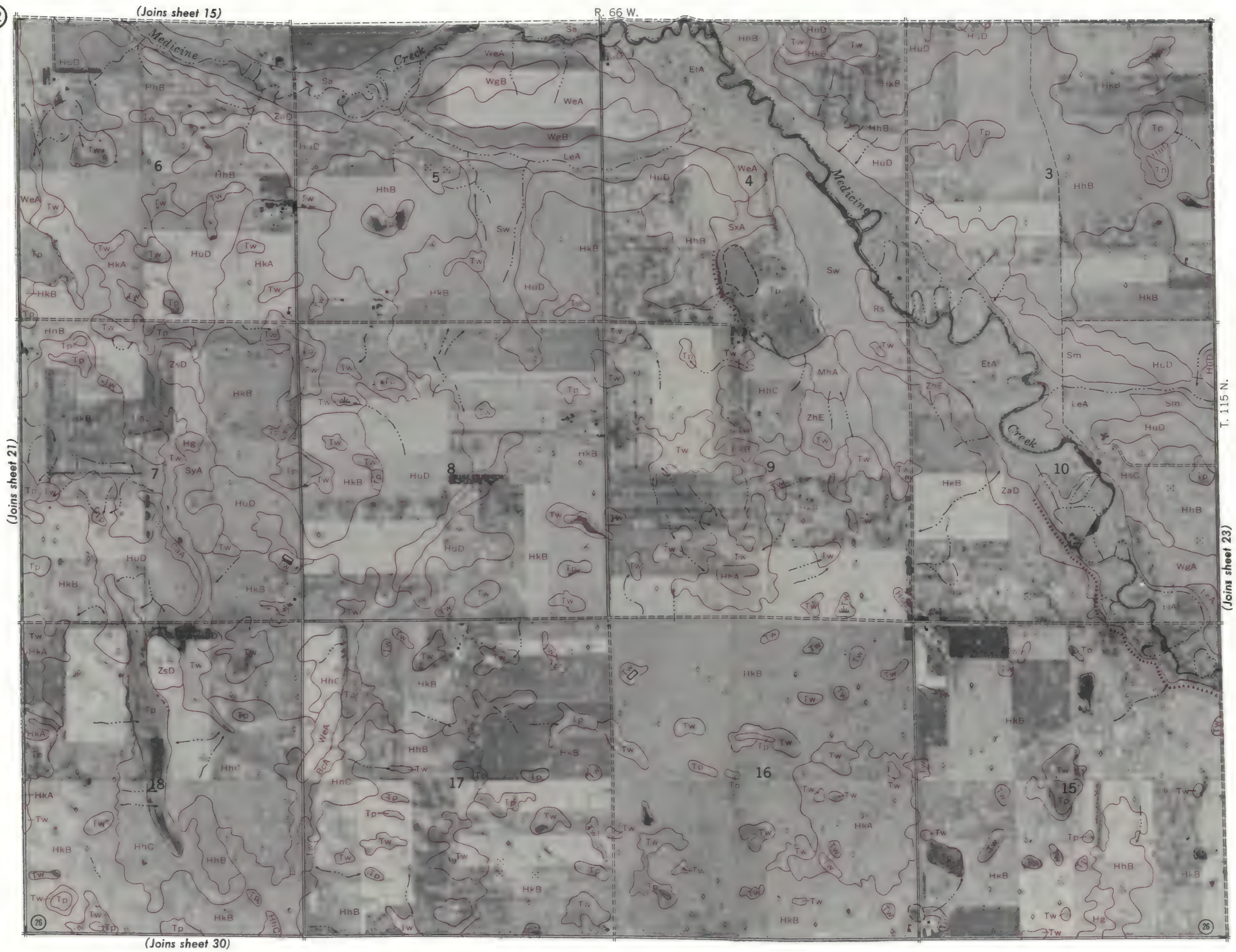
North Wolf Creek

0 1 Mile

Scale 1:20 000

0 5000 Feet

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 22



0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

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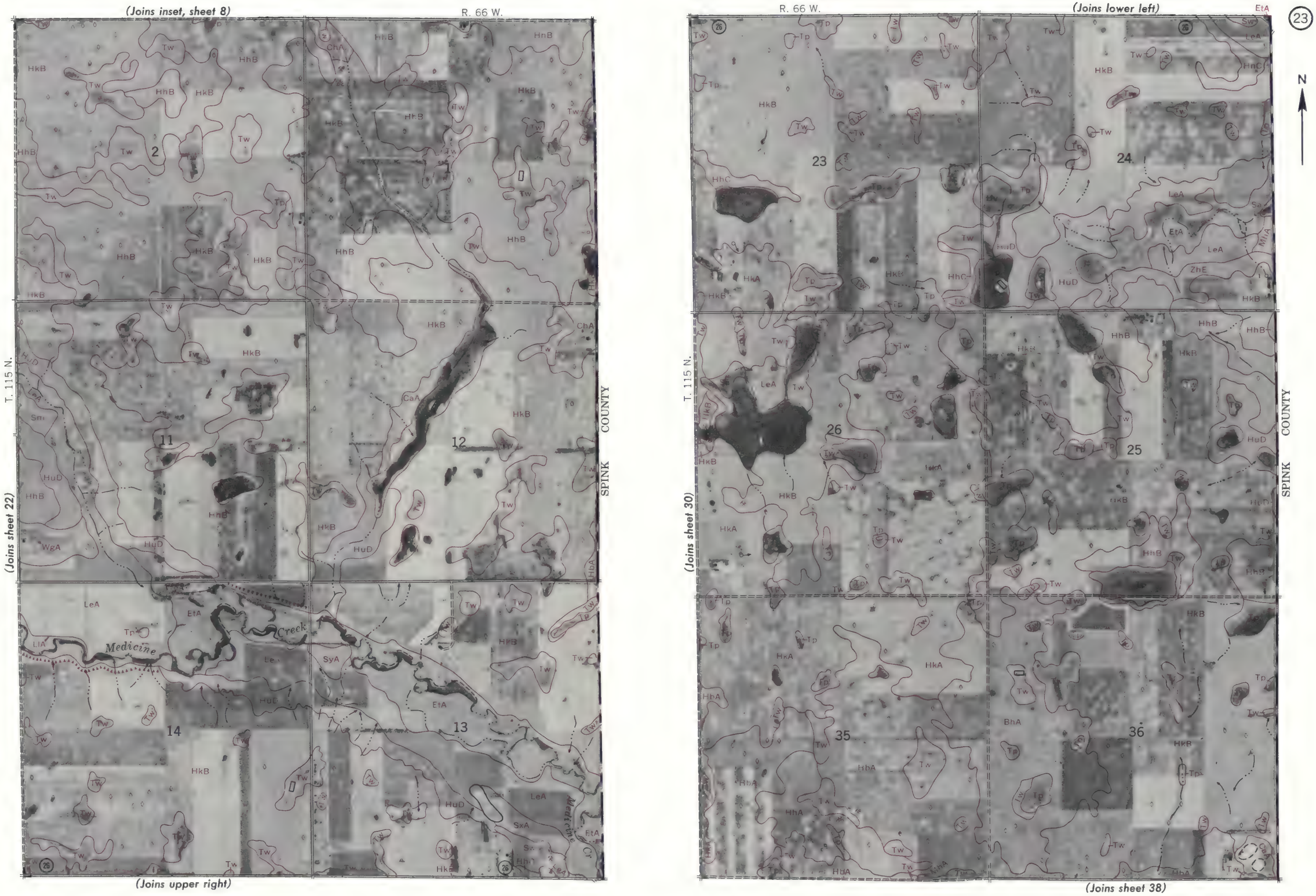
Range, township, and section corners shown on this map are indefinite.



24

N

(Joins sheet 16)

R. 70 W.

T. 115 N.

HYDE COUNTY

(Joins sheet 25)

(Joins sheet 31)

Scale 1:20 000

0 ½ 1 Mile

0 5000 Feet

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 25

R. 70 W. | R. 69 W.

(Joins sheet 17)

25

N

T. 115 N.

(Joins sheet 24)

(Joins sheet 26)

(Joins sheet 32)

23 24 19 20

26 25 30 29

35 36 31 32

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the South Dakota State College, Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 26

(26)

(Joins sheet 18)

R. 69 W.

N

T. 115 N.

(Joins sheet 25)

(Joins sheet 27)

(Joins sheet 33)

21 22 23 24

28 27 26 25

33 34 35 36

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

R. 68 W.

(Joins sheet 19)

27

N

T. 115 N.

(Joins sheet 26)

(Joins sheet 28)

(Joins sheet 34)

Hargens School

Shaefer Creek

Shaefer

19 20 21 22

30 29 28 27

31 32 33 34

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the South Dakota State College, Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 28

(28)

N

(Joins sheet 20)

R. 68 W. | R. 67 W.

T. 115 N.

(Joins sheet 27)

(Joins sheet 29)

(Joins sheet 35)

Shaefer Creek

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 29

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the South Dakota State College, Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 30

(30)

N

(Joins sheet 22)

R. 66 W.

T. 115 N.

(Joins sheet 29)

(Joins inset, sheet 23)

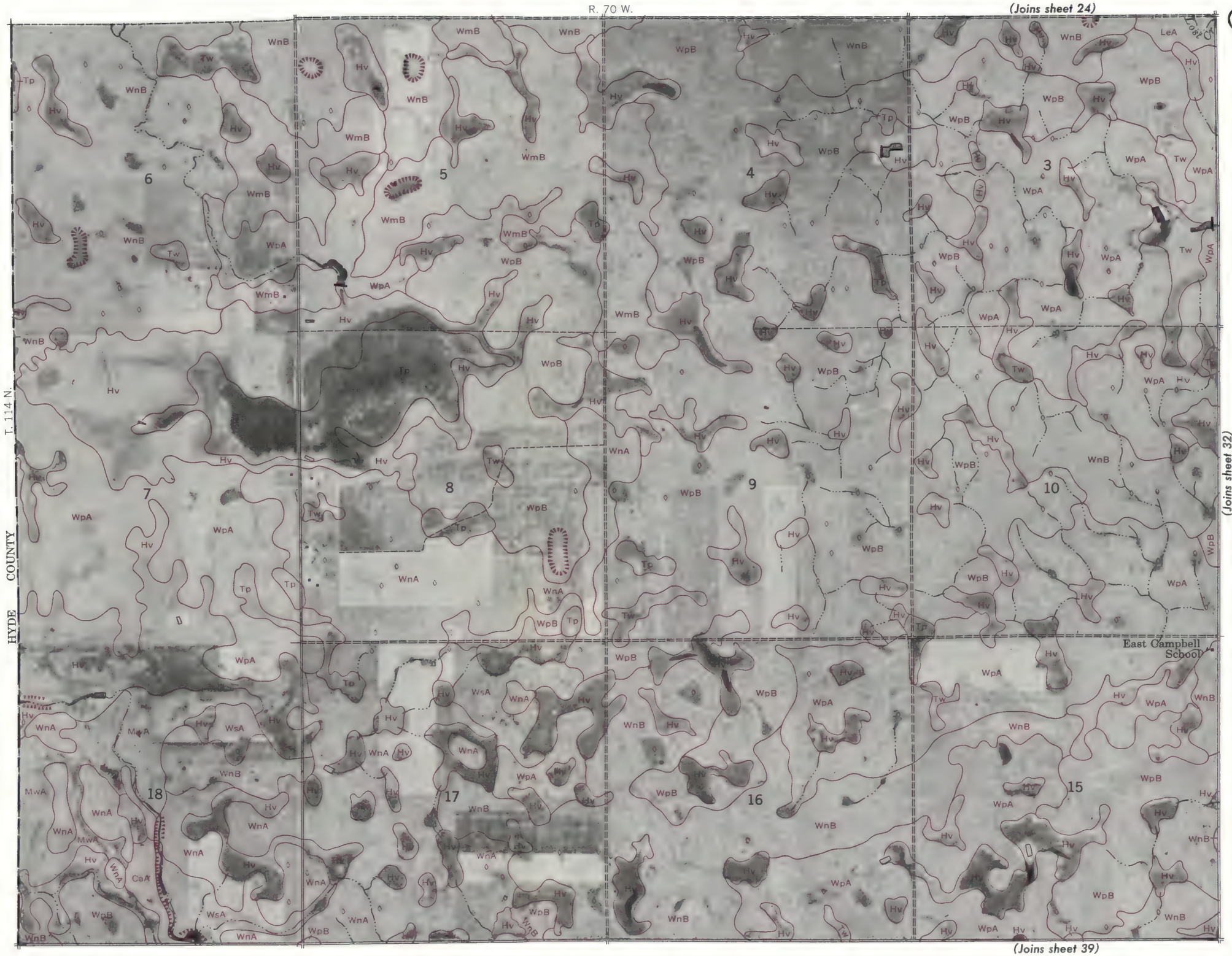
(Joins sheet 37)

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 31



This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the South Dakota State College, Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

32

R. 70 W. | R. 69 W.

N

T. 114 N.

(Joins sheet 25)

(Joins sheet 31)

(Joins sheet 33)

(Joins sheet 40)

Lost Creek

Lost Creek

1 2 5 6 7 8 11 12 13 14 17 18

LeA WmB WnA WnB WpA WpB WmB CaA Hv Tp Tw MdA WsA

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

R. 69 W.

(Joins sheet 26)

33

N

T. 114 N.

(Joins sheet 32)

(Joins sheet 34)

(Joins sheet 41)

Yan Zee School

Lost Creek

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 34

(34)

N

(Joins sheet 27)

R. 68 W.

T. 114 N.

(Joins sheet 33)

(Joins sheet 35)

(Joins sheet 42)

Eaton School

Lost Creek

Lost Creek

GRAVEL PIT

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 36

(36)

R. 67 W.

T. 114 N.

N

(Joins sheet 29)

(Joins sheet 35)

(Joins sheet 37)

(Joins sheet 44)

Scale 1:20 000

0 ½ 1 Mile

0 5000 Feet

38

N

R. 66 W.

R. 66 W.

T. 114 N.

T. 114 N.

SPINK COUNTY

SPINK COUNTY

(Joins inset, sheet 23)

(Joins lower left)

(Joins sheet 37)

(Joins sheet 45)

(Joins upper right)

(Joins sheet 53)

1 2 11 12 13 14 23 24 25 26 35 36

Wild Creek

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 39

R. 70 W.

(Joins sheet 31)

39

N

West Campbell School

T. 114 N.

HYDE COUNTY

(Joins sheet 40)

(Joins sheet 46)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the South Dakota State College, Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 40

(40)

N

R. 70 W. R. 69 W.

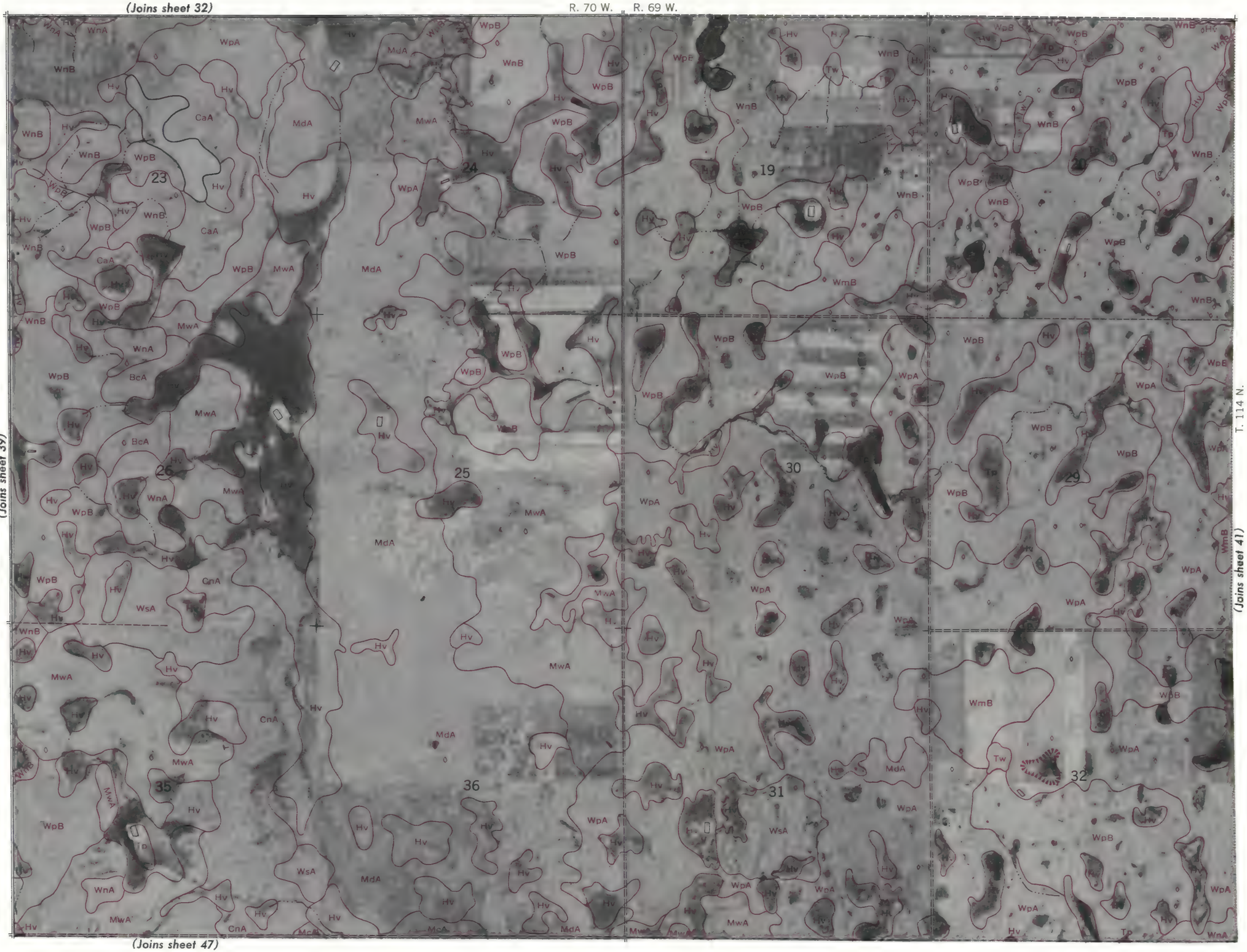
T. 114 N.

(Joins sheet 32)

(Joins sheet 39)

(Joins sheet 41)

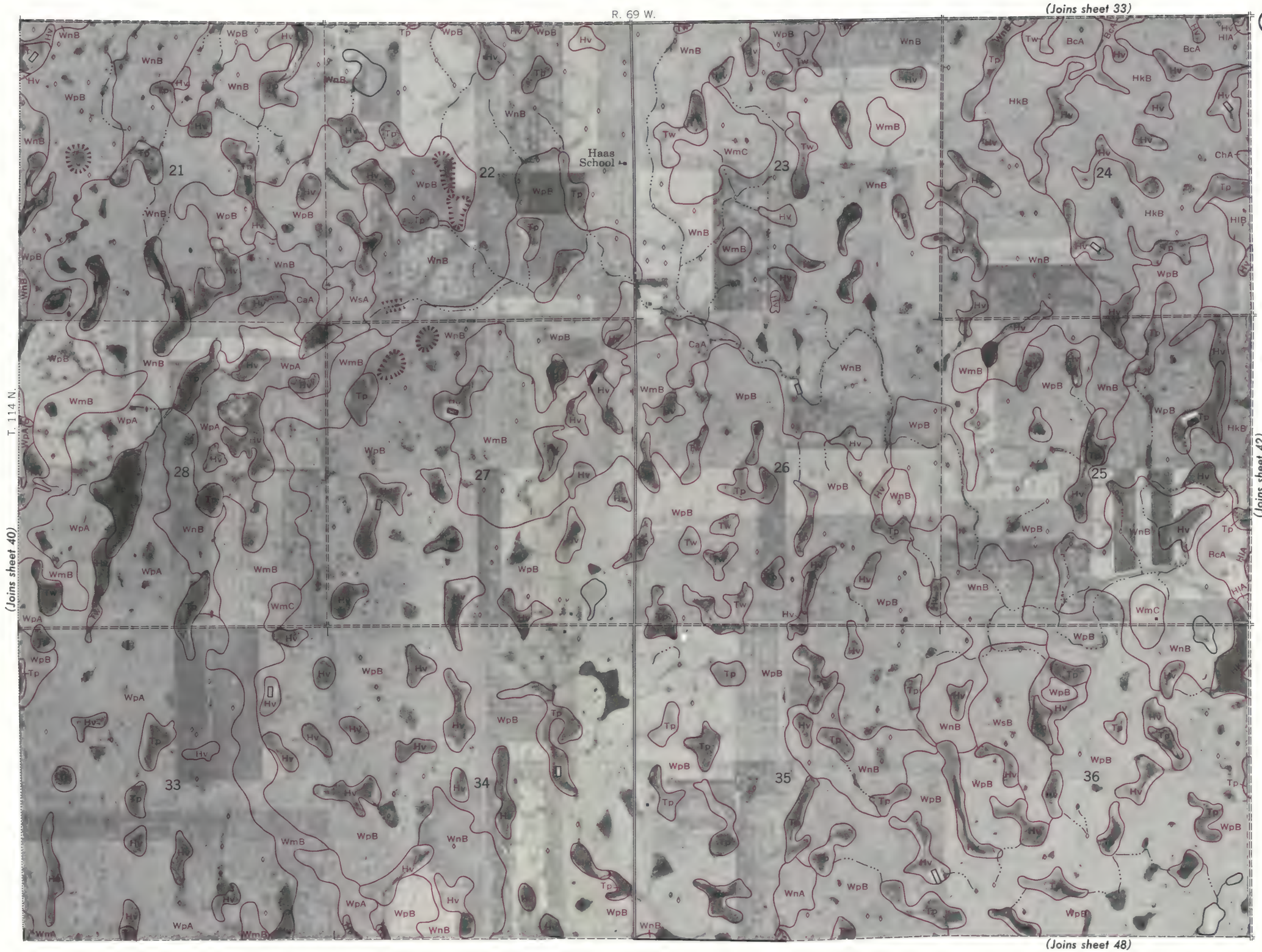
(Joins sheet 47)



0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the South Dakota State College, Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.



0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

(Joins sheet 34)

R. 68 W.

(Joins sheet 41)

(Joins sheet 43)

T. 114 N.

(Joins sheet 49)

Prairie View School

Lost Creek

Wolf Creek

Scale 1:20 000

0 ½ 1 Mile

0 5000 Feet

Range, township, and section corners shown on this map are indefinite.

R. 68 W. | R. 67 W.

T. 114 N.

(Joins sheet 35)

(Joins sheet 42)

(Joins sheet 44)

(Joins sheet 50)

N

Scale 1:20 000

0 ½ 1 Mile

0 5000 Feet

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 44

(44)

N

(Joins sheet 36)

R. 67 W.

T. 114 N.

(Joins sheet 43)

(Joins sheet 45)

(Joins sheet 51)

Lost Creek

Wolf Creek

21 22 23 24

28 27 26 25

33 34 35 36

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 45

R. 66 W.

(Joins sheet 37)

45

N

T. 114 N.

(Joins sheet 44)

(Joins inset, sheet 38)

(Joins sheet 52)

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the South Dakota State College, Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

(46)

(Joins sheet 39)

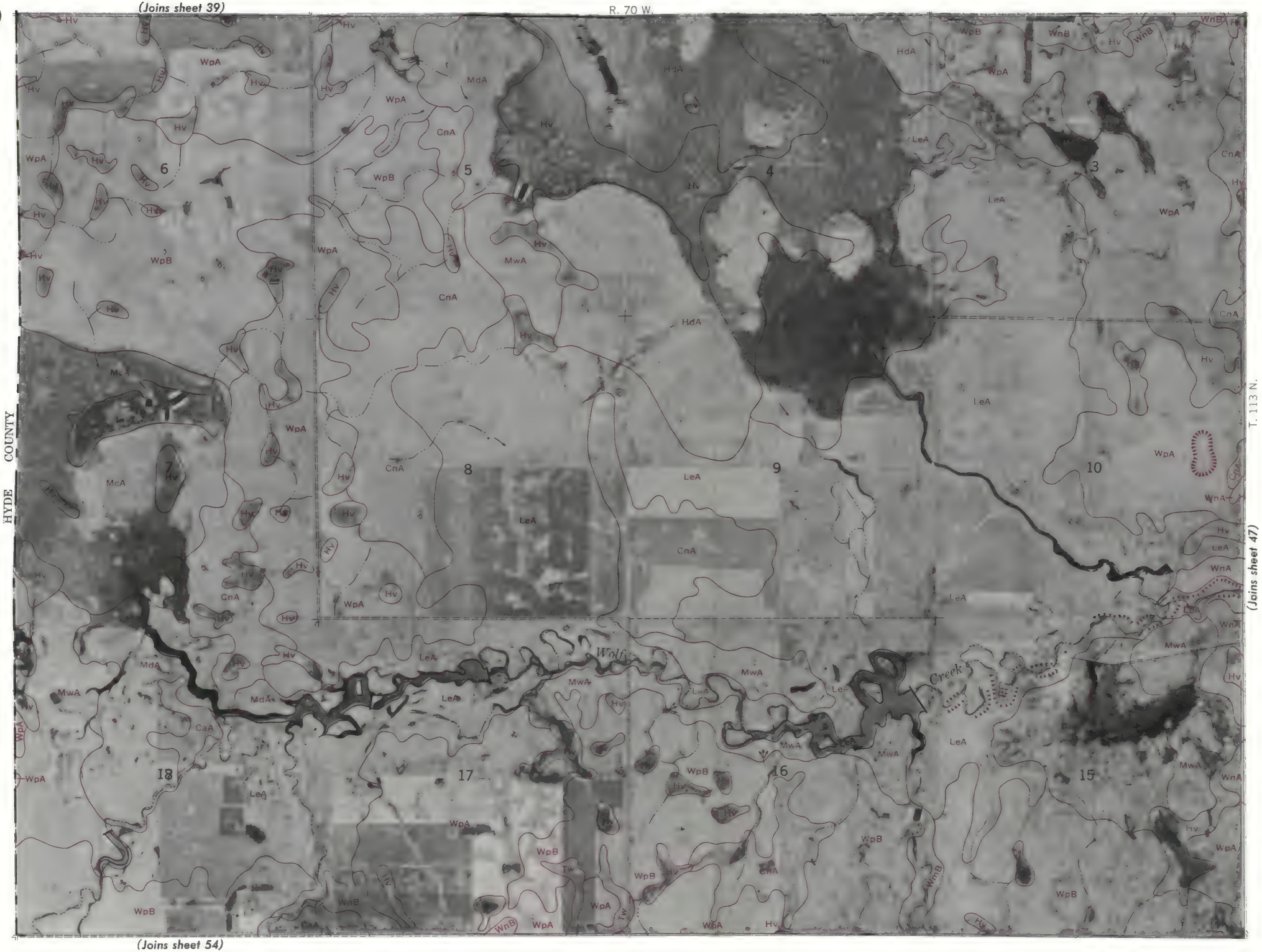
R. 70 W.

N

HYDE COUNTY

T. 113 N.

(Joins sheet 47)

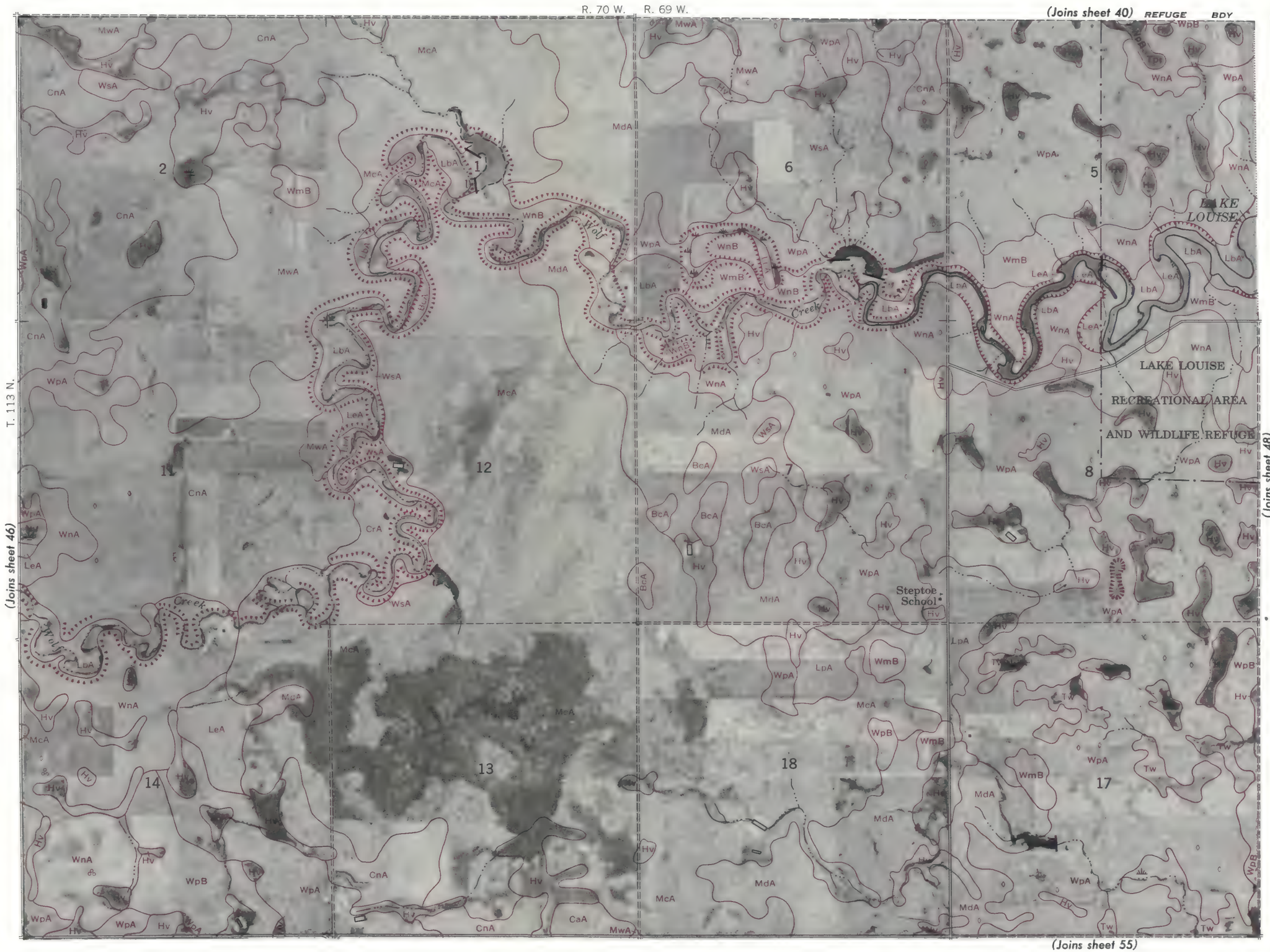


(Joins sheet 54)

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet



0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

48

REFUGE BDY (Joins sheet 41)

R. 69 W.

N

LAKE LOUISE

LAKE LOUISE RECREATIONAL AREA AND WILDLIFE REFUGE

Greenleaf Church

Prairie View School

T. 113 N.

(Joins sheet 47)

(Joins sheet 49)

(Joins sheet 56)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

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Range, township, and section corners shown on this map are indefinite.

R. 68 W.

T. 113 N.

(Joins sheet 42)

(Joins sheet 48)

(Joins sheet 50)

(Joins sheet 57)

N

Moncur School

Wolf Creek

Little Creek

Turtle Creek

Scale 1:20 000

0 ½ 1 Mile

0 5000 Feet

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 50

(50)

N

(Joins sheet 43)

R. 68 W. | R. 67 W.

T. 113 N.

(Joins sheet 49)

(Joins sheet 51)

(Joins sheet 58)

Scale 1:20 000

0 ½ 1 Mile

0 5000 Feet

R. 67 W.

(Joins sheet 44)

51

N

T. 113 N.

(Joins sheet 50)

(Joins sheet 52)

(Joins sheet 59)

Creek

Turtle

Little

Creek

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

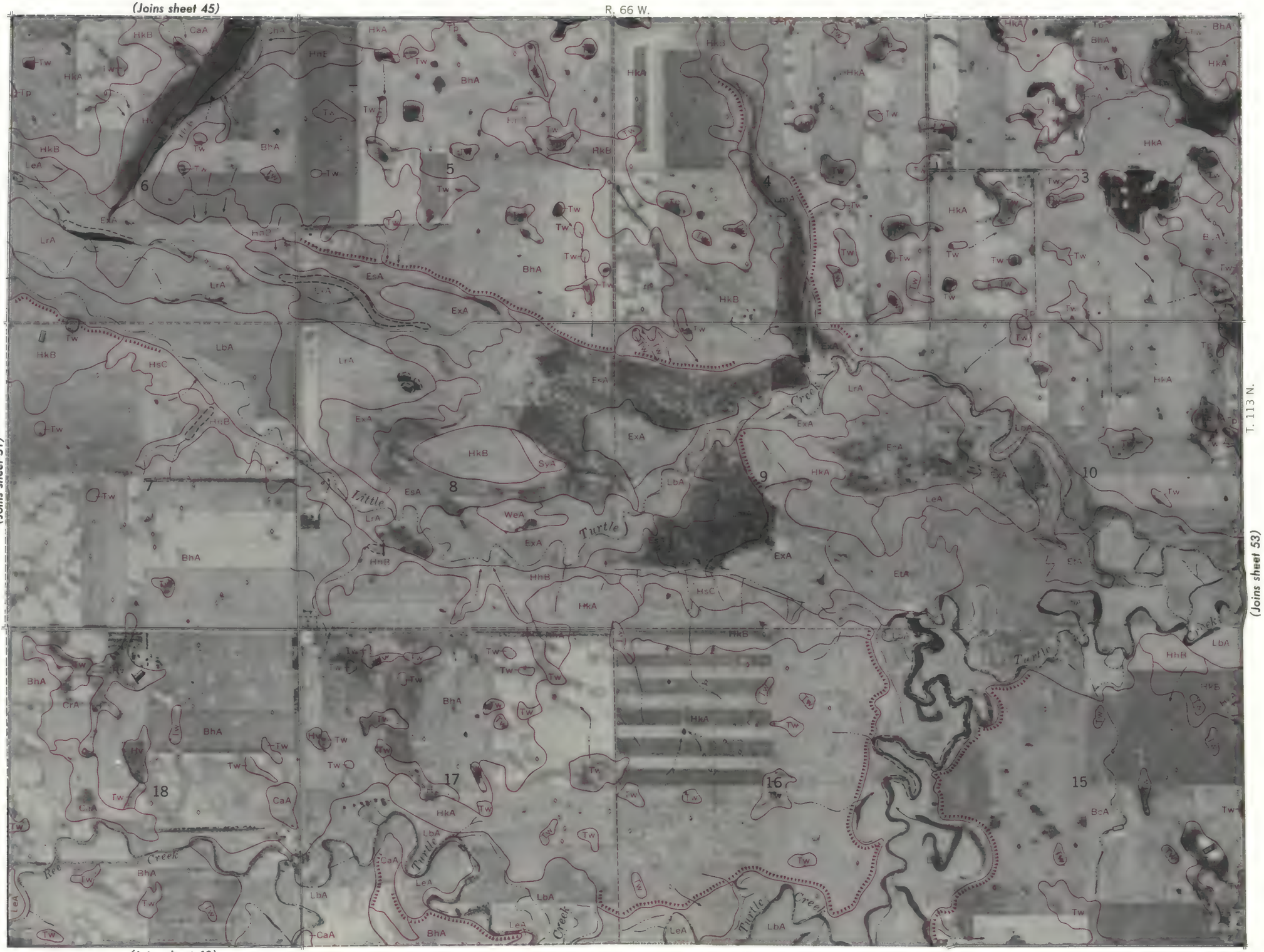
HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 52

52

(Joins sheet 45)

R. 66 W.

N



(Joins sheet 51)

(Joins sheet 53)

(Joins sheet 60)

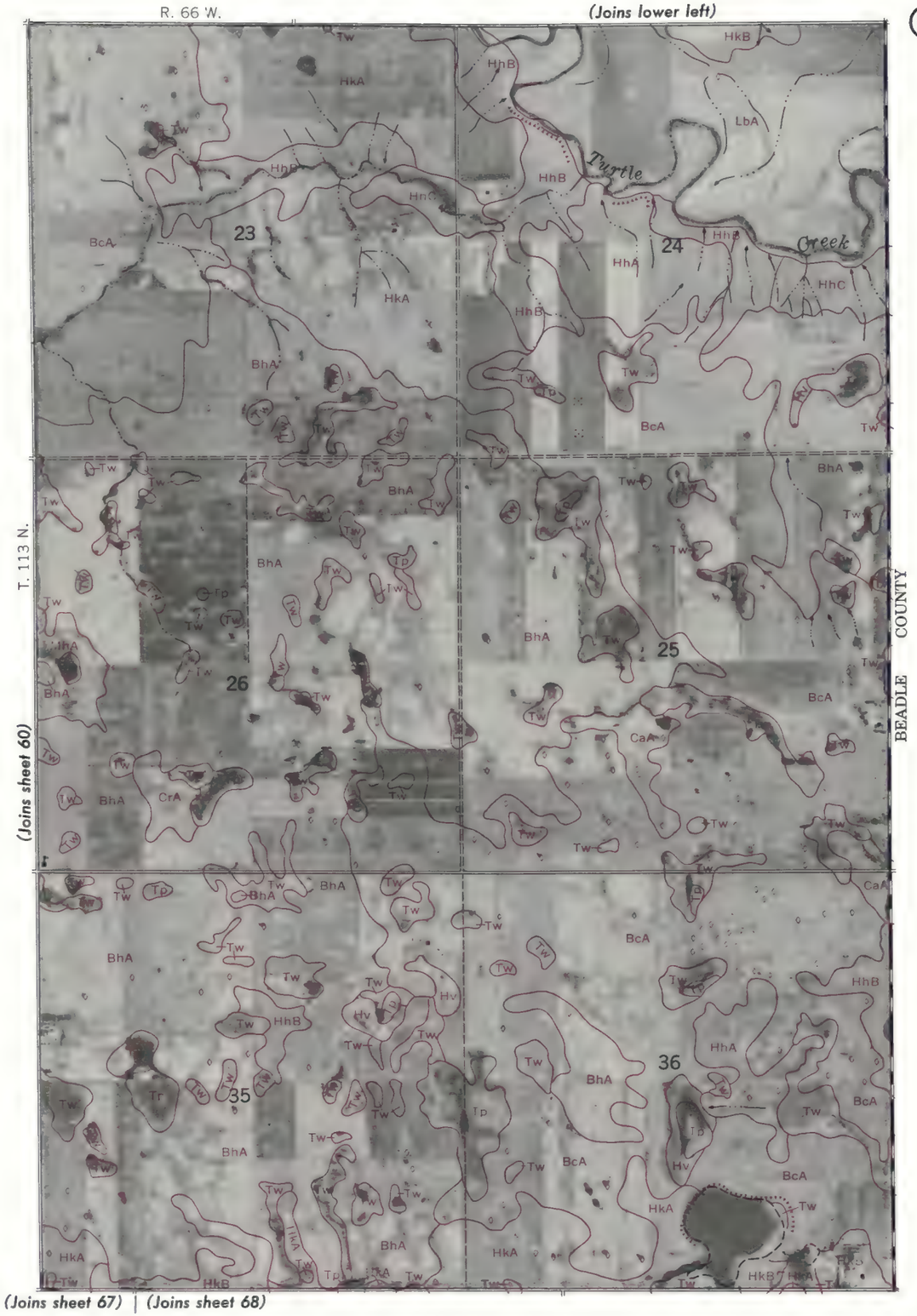
T. 113 N.

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

Range, township, and section corners shown on this map are indefinite.



(Joins sheet 67) | (Joins sheet 68)

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

(54)

(Joins sheet 46)

R. 70 W.

N

West Riverside School

Creek

Little

Creek

T. 113 N.

(Joins sheet 55)

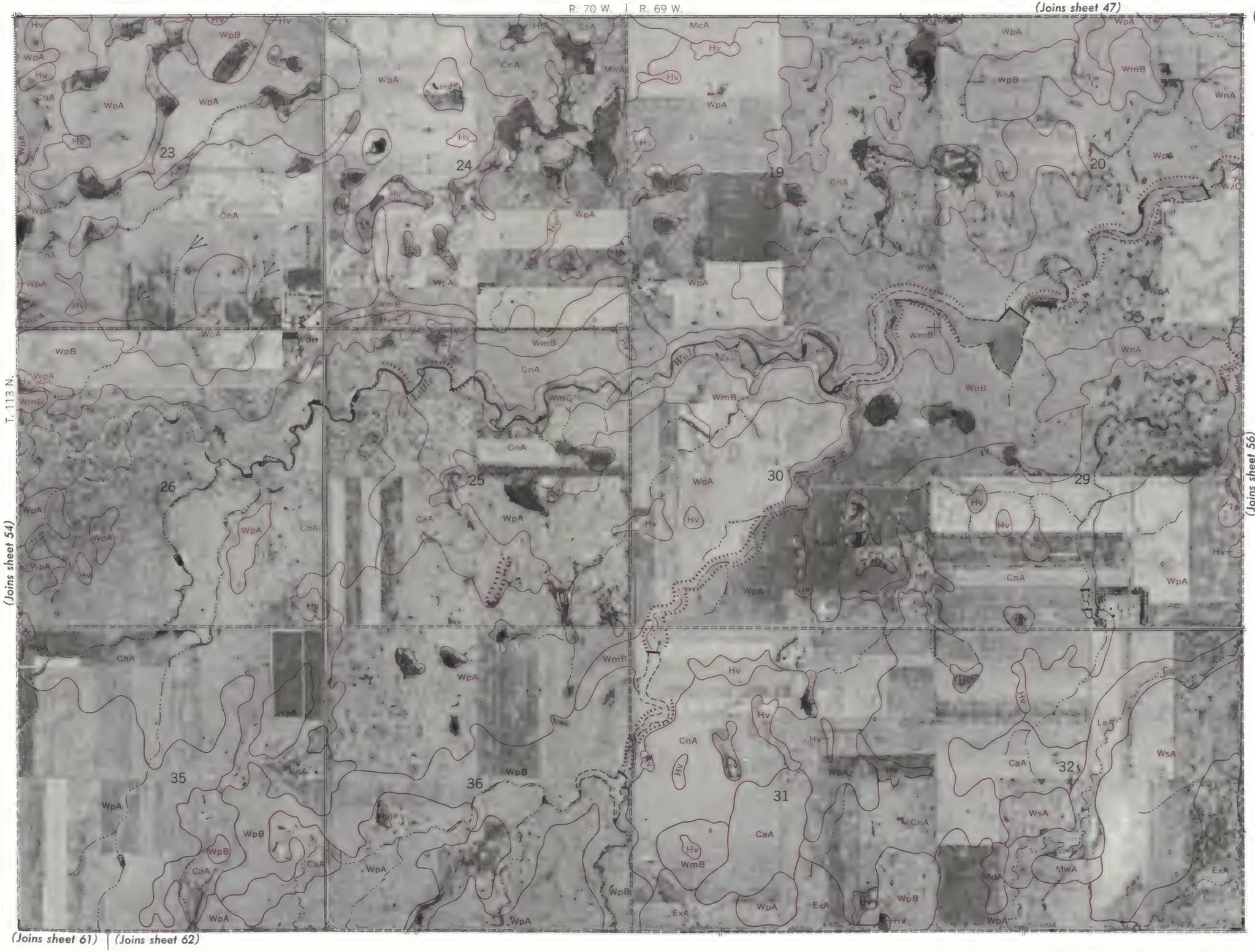
HYDE COUNTY

(Joins sheet 61)

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet




56
(Joins sheet 48)
R. 69 W.
N
(Joins sheet 55)
(Joins sheet 57)
T. 113 N.
(Joins sheet 62)
(Joins sheet 63)
21
22
23
24
28
27
26
25
33
34
35
36
Matson School
0
½
1 Mile
Scale 1:20 000
0
5000 Feet

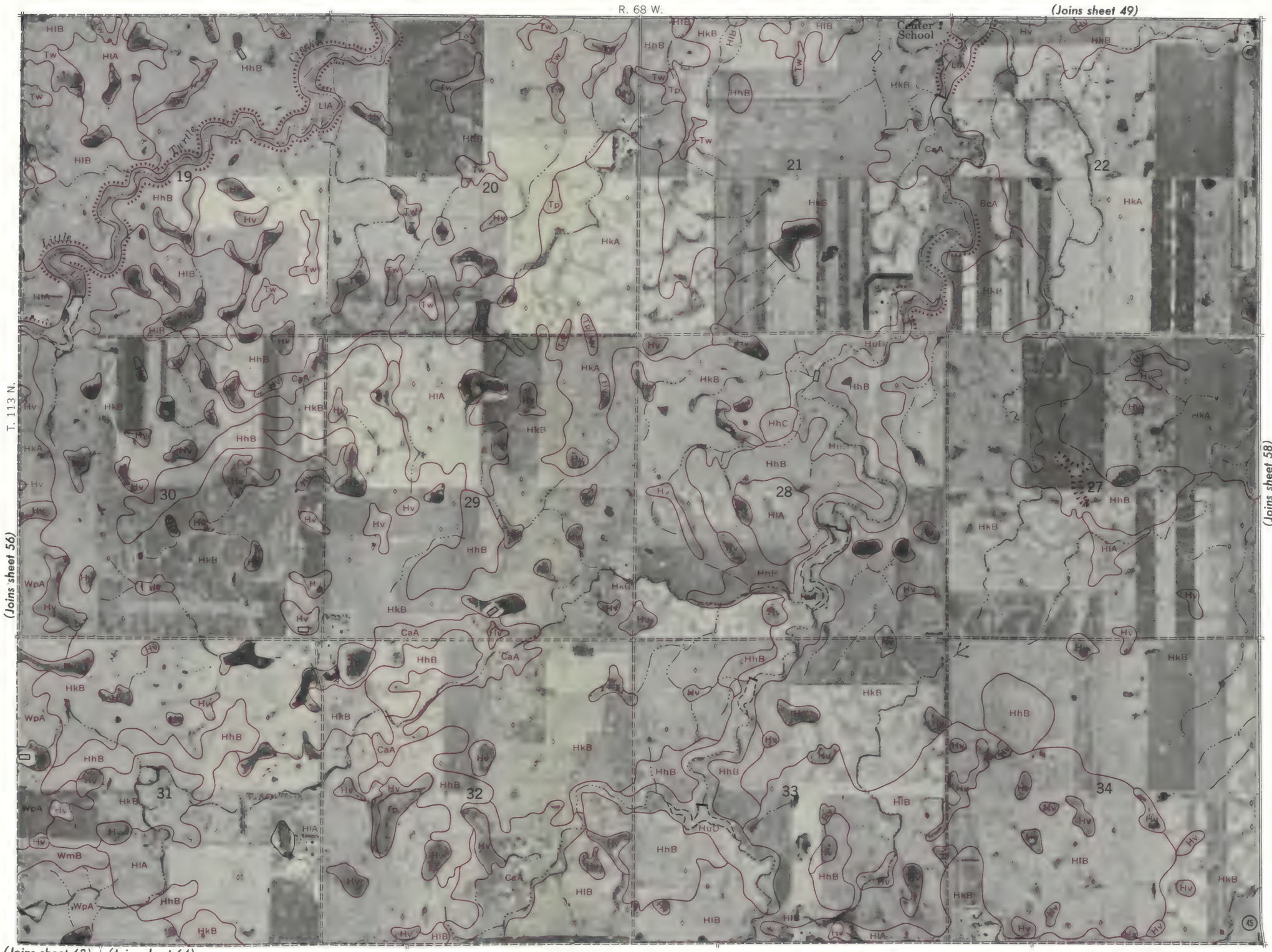
HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 57

This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the South Dakota State College, Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

R. 68 W.

T. 113 N.



57

N

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

(58)

(Joins sheet 50)

R. 68 W. | R. 67 W.

N

T. 113 N.

(Joins sheet 57)

(Joins sheet 59)

(Joins sheet 64) | (Joins sheet 65)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the South Dakota State College, Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

R. 67 W.

T. 113 N.

(Joins sheet 51)

(Joins sheet 58)

(Joins sheet 60)

(Joins sheet 65) | (Joins sheet 66)

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

(Joins sheet 52)

R. 66 W.

60

N

T. 113 N.

(Joins sheet 59)

(Joins inset, sheet 53)

(Joins sheet 66)

(Joins sheet 67)

Turtle Creek

Pearl Creek

Cr.

19 20 21 22

30 29 28 27

31 32 33 34

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

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0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 61

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 62

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

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Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 63

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 64

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

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Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 65

(Joins sheet 65)

(Joins sheet 67)
(Joins sheet 59)
(Joins sheet 60)

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 66

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

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Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 67

N

68

N

R. 66 W.

(Joins inset, sheet 53)

T. 112 N.

BEADLE COUNTY

(Joins sheet 67)

(Joins upper right)

(Joins lower left)

(Joins sheet 75)

(Joins sheet 83)

Pearl Creek

CHICAGO AND NORTH WESTERN

WESSINGTON CEMETERY

Scale 1:20 000

0 ½ 1 Mile

0 5000 Feet

R. 70 W.

(Joins sheet 61)

69

N

T. 112 N.

HYDE COUNTY

(Joins sheet 70)

(Joins sheet 76)

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

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Range, township, and section corners shown on this map are indefinite.

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 70

(70)

N

R. 70 W. R. 69 W.

T. 112 N.

(Joins sheet 62)

(Joins sheet 69)

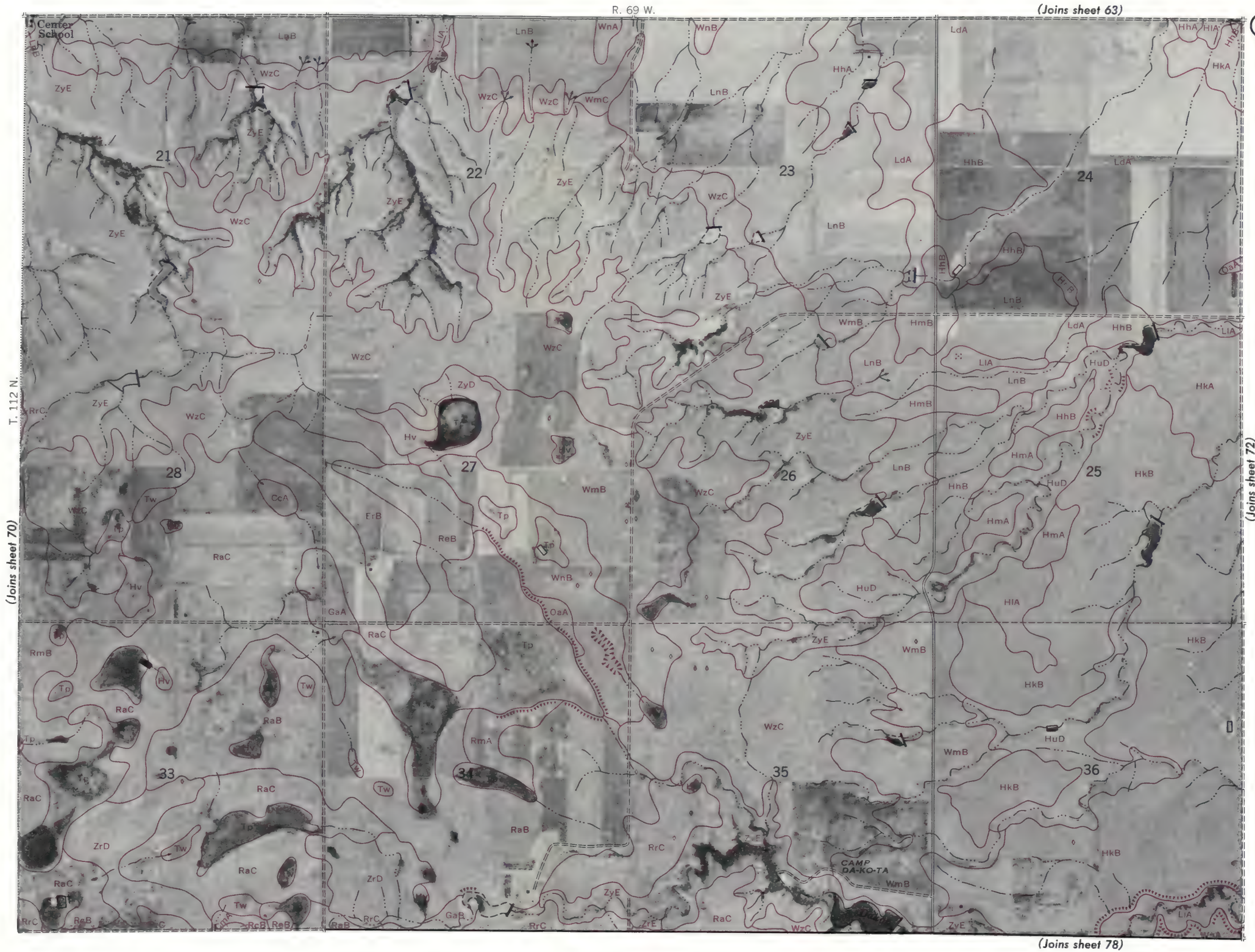
(Joins sheet 71)

(Joins sheet 77)

CITY DUMP

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 71



0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the South Dakota State College, Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 72

(72)

(Joins sheet 64)

R. 68 W.

N

T. 112 N.

(Joins sheet 71)

(Joins sheet 73)

(Joins sheet 79)

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 73

R. 68 W. | R. 67 W.

(Joins sheet 65)

73

N

T. 112 N.

(Joins sheet 72)

(Joins sheet 74)

(Joins sheet 80)

Jones Lake

Turtle Creek

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the South Dakota State College, Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 74

(74)

N

R. 67 W.

T. 112 N.

(Joins sheet 66)

(Joins sheet 73)

(Joins sheet 75)

(Joins sheet 81)

21 22 23 24

28 27 26 25

33 34 35 36

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 75

Range, township, and section corners shown on this map are indefinite.

R. 66 W.

T. 112 N.

(Joins sheet 67)

(Joins sheet 74)

(Joins inset, sheet 68)

(Joins sheet 82)

75

N

Vanland

Springdale School

CHICAGO AND NORTH WESTERN

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 76

76

N

(Joins sheet 69)

R. 70 W.

HYDE COUNTY

T. 111 N.

(Joins sheet 77)

(Joins sheet 84)

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 77

R. 70 W. | R. 69 W.

(Joins sheet 70)

77

N

T. 111 N.

(Joins sheet 76)

(Joins sheet 78)

(Joins sheet 85)

Scale 1:20 000

0 ½ 1 Mile

0 5000 Feet

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Range, township, and section corners shown on this map are indefinite.

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 78

(78)

N

R. 69 W.

T. 111 N.

(Joins sheet 71)

(Joins sheet 77)

(Joins sheet 79)

(Joins sheet 86)

Lake Dakota

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

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Range, township, and section corners shown on this map are indefinite.

R. 68 W.

T. 111 N.

(Joins sheet 72)

(Joins sheet 78)

(Joins sheet 80)

(Joins sheet 87)

79

N

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

(80)

N

(Joins sheet 73)

R. 68 W. | R. 67 W.

(Joins sheet 79)

(Joins sheet 81)

T. 111 N.

Lone Star School

Turtle Creek

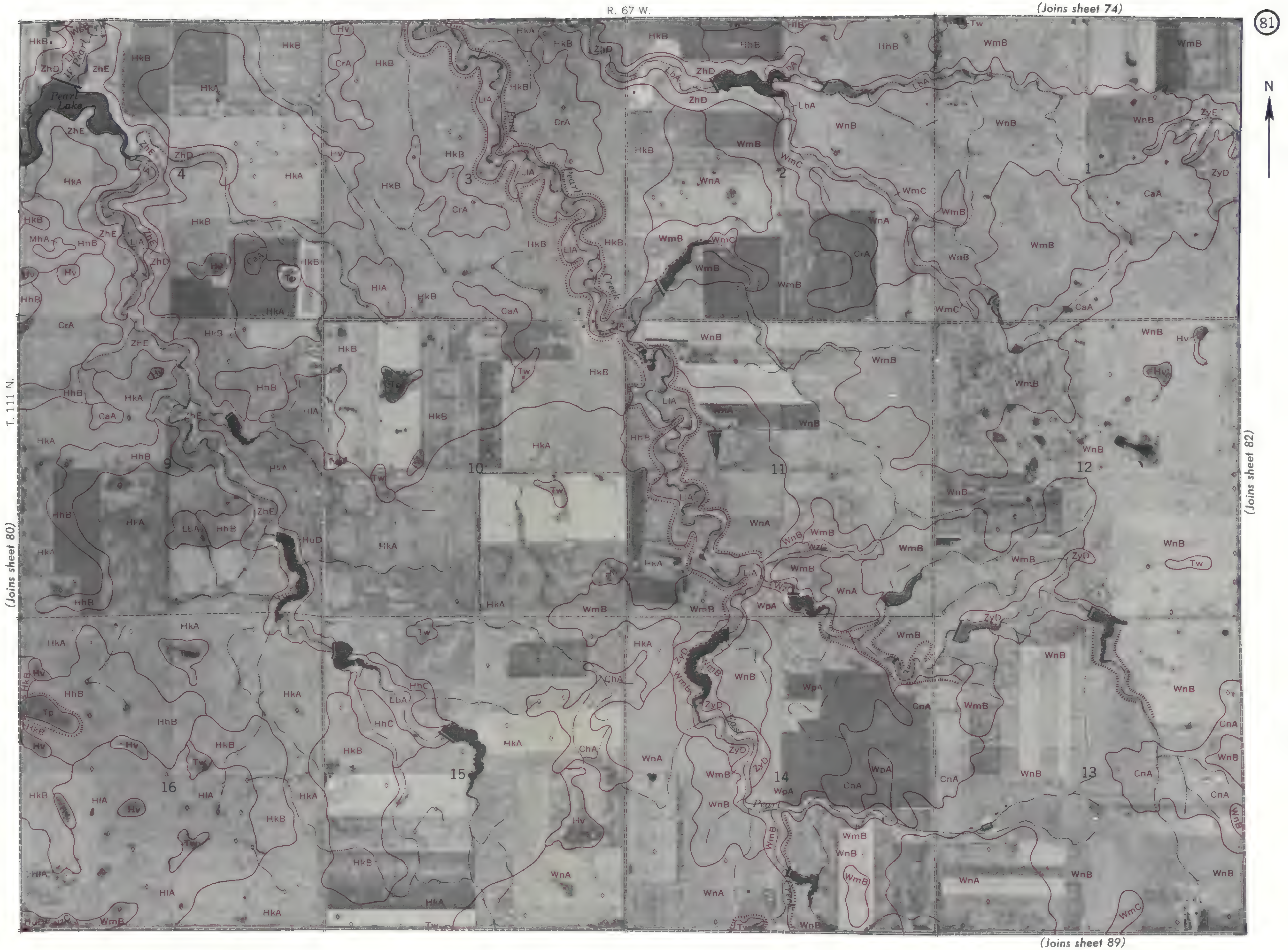
Peat Lake

Pearl Creek

Lone Tree School

(Joins sheet 88)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet



0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

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Range, township, and section corners shown on this map are indefinite.

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 82

(82)

(Joins sheet 75)

R. 66 W.

N

T. 111 N.

(Joins sheet 81)

(Joins sheet 83)

(Joins sheet 90)

Harris School

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

(Joins inset, sheet 68)

R. 66 W.

(Joins lower left)

N

T. 111 N.

Wessington

Wessington Cemetery

Creek

Bothwell School

Silver Creek

BEADLE COUNTY

(Joins sheet 82)

(Joins upper right)

(Joins sheet 90)

(Joins sheet 98)

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 84

(84)

N

R. 70 W.

T. 111 N.

HYDE COUNTY

(Joins sheet 76)

(Joins sheet 85)

(Joins sheet 91)

ORIGINAL CROW CREEK INDIAN RESERVATION BOUNDARY

19 20 21 22 27 28 29 30 31 32 33 34

RpC ReB RrC ReD ZrD ErB ZmE ZrE Rs GaB OrB PrD GaA HcA Ru OaA LsA RaB RaC HeA PrC Sm LtD Tp ZmD

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 85

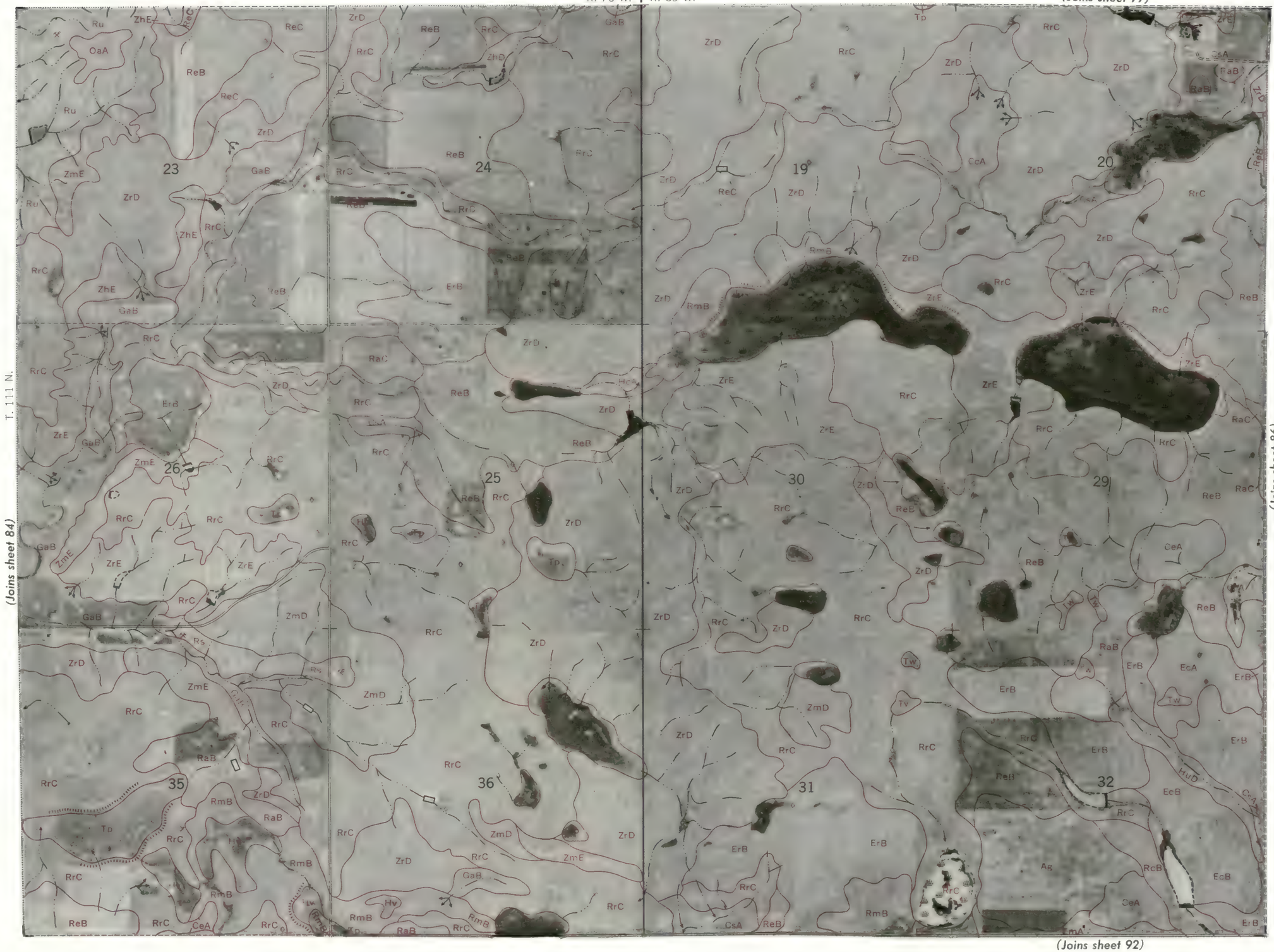
R. 70 W. | R. 69 W.

(Joins sheet 77)

85

N

T. 111 N.



(Joins sheet 84)

(Joins sheet 92)

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

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Range, township, and section corners shown on this map are indefinite.

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 86

(86)

(Joins sheet 78)

R. 69 W.

N

T. 111 N.

(Joins sheet 85)

(Joins sheet 87)

(Joins sheet 93)

COLLINS SLOUGH

HUTTERITE COLONY

21 22 23 24 25 26 27 28 33 34 35 36

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 87

R. 68 W.

(Joins sheet 79)

87

N

T. 111 N.

Corrin School

(Joins sheet 86)

(Joins sheet 88)

(Joins sheet 94)

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Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 88

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 89

R. 67 W.

(Joins sheet 81)

89

N

T. 111 N.

(Joins sheet 88)

(Joins sheet 90)

(Joins sheet 96)

Evans School

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

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Range, township, and section corners shown on this map are indefinite.

N

(Joins sheet 82)

R. 66 W.

T. 111 N.

(Joins sheet 89)

(Joins inset, sheet 83)

(Joins sheet 97)

Rombough School

19 20 21 22 27 28 29 30 31 32 33 34

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 91

(Joins sheet 84)

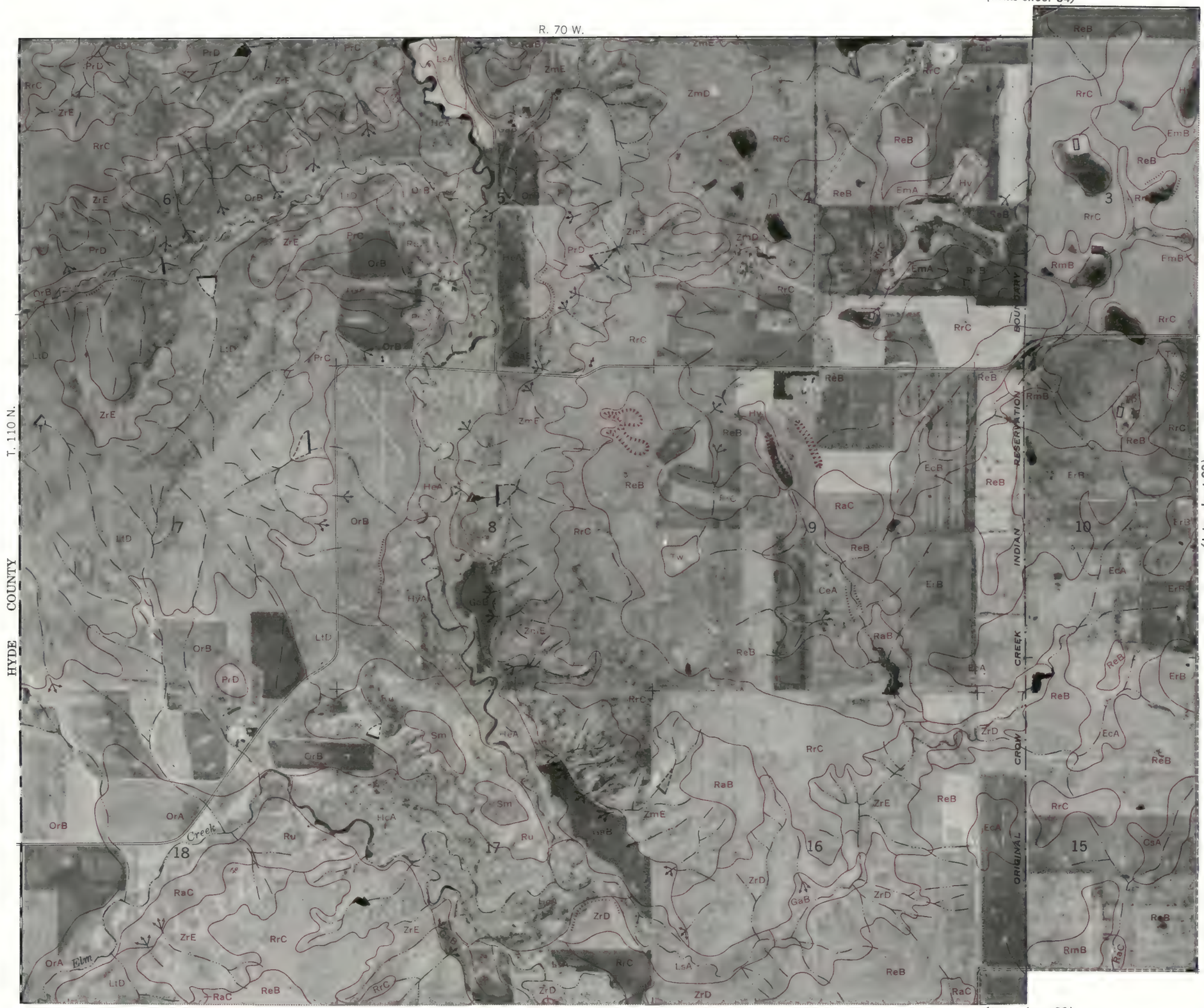
R. 70 W.

91

N

T. 110 N.

HYDE COUNTY



(Joins sheet 92)

(Joins sheet 99)

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the South Dakota State College, Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 92

(92)

N

(Joins sheet 85)

R. 70 W. | R. 69 W.

T. 110 N.

(Joins sheet 91)

(Joins sheet 93)

(Joins sheet 100)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

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Range, township, and section corners shown on this map are indefinite.

R. 69 W.

(Joins sheet 86)

93

N

T. 110 N.

COLLINS SLOUGH

(Joins sheet 92)

(Joins sheet 94)

(Joins sheet 101)

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 94

(94)

(Joins sheet 87)

R. 68 W.

N

T. 110 N.

(Joins sheet 93)

(Joins sheet 95)

(Joins sheet 102)

SUNSHINE BIBLE ACADEMY

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 95

R. 68 W | R. 67 W.

(Joins sheet 88)

95

N

T. 110 N.

(Joins sheet 94)

(Joins sheet 96)

(Joins sheet 103)

Nelson School

Horseshoe Bend School

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

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Range, township, and section corners shown on this map are indefinite.

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 96

96

N

(Joins sheet 89)

R. 67 W.

T. 110 N.

(Joins sheet 95)

(Joins sheet 97)

(Joins sheet 104)

Center School

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 97

R. 66 W.

(Joins sheet 90)

97

N

T. 110 N.

(Joins sheet 96)

(Joins sheet 98)

(Joins sheet 105)

Rowen School

0 ½ 1 Mile

Scale 1:20 000

0 5000 Feet

This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the South Dakota State College, Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.

98

N

(Joins inset, sheet 83)

R. 66 W.

(Joins sheet 97)

T. 110 N.

BEADLE COUNTY

McNeil School

McGillvery School

Stand Creek

(Joins upper right)

(Joins lower left)

(Joins sheet 105)

(Joins sheet 113)

0 ½ 1 Mile

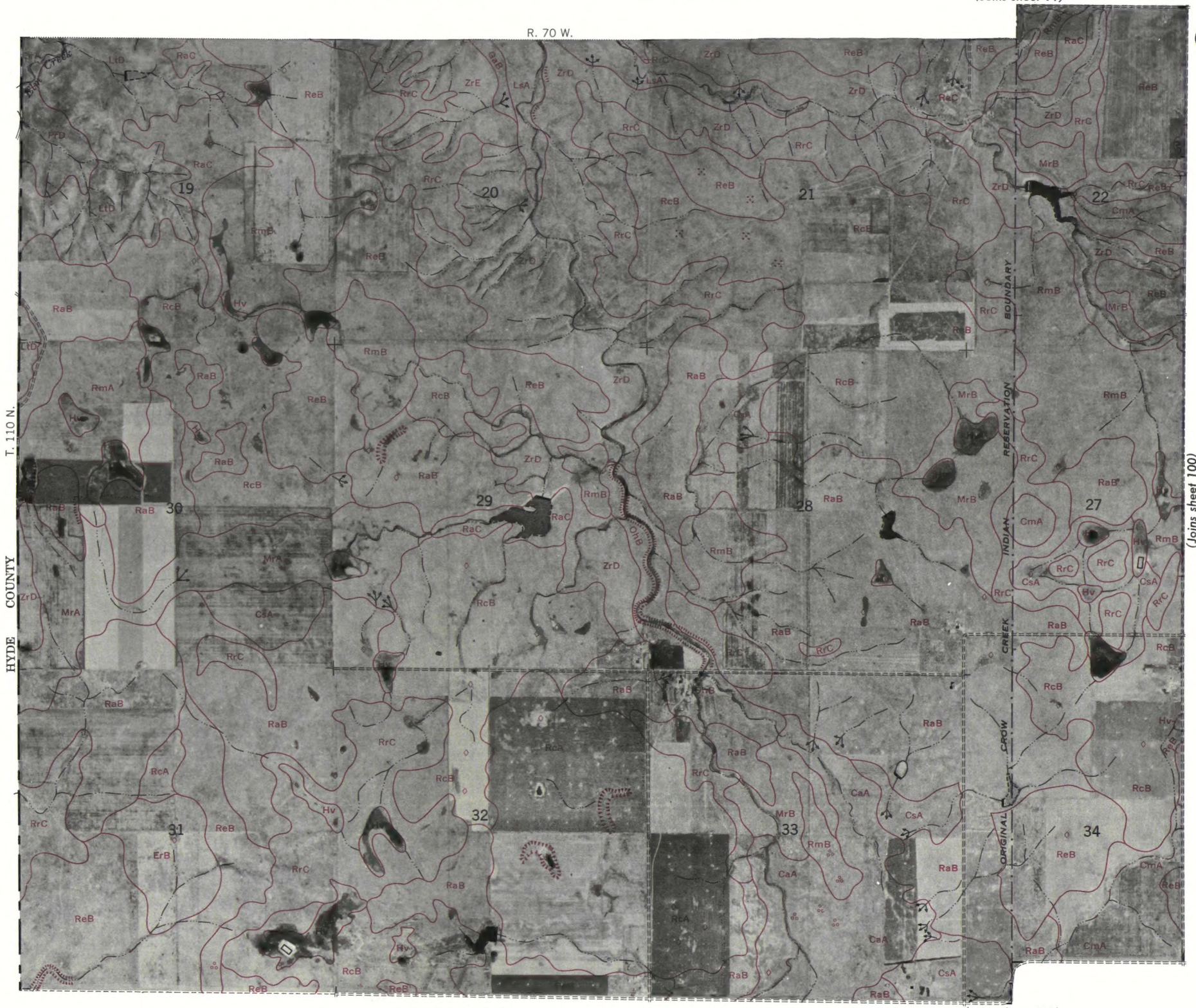
Scale 1:20 000

0 5000 Feet

HAND COUNTY, SOUTH DAKOTA — SHEET NUMBER 99

(Joins sheet 91)

R. 70 W.



(Joins sheet 100)

(Joins sheet 106)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

This map is one of a set compiled in 1962 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the South Dakota State College, Agricultural Experiment Station.

Range, township, and section corners shown on this map are indefinite.